THE ENGINEER

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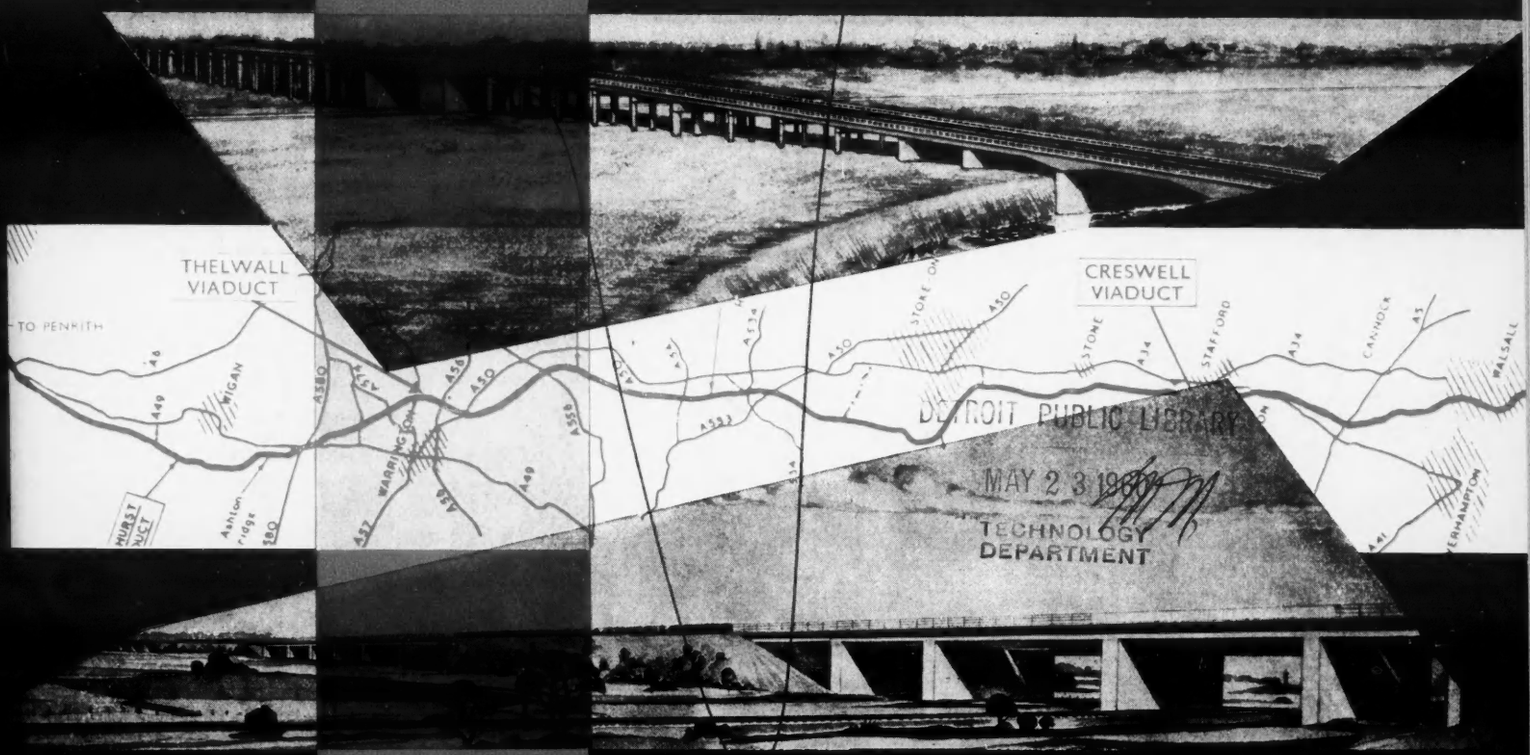

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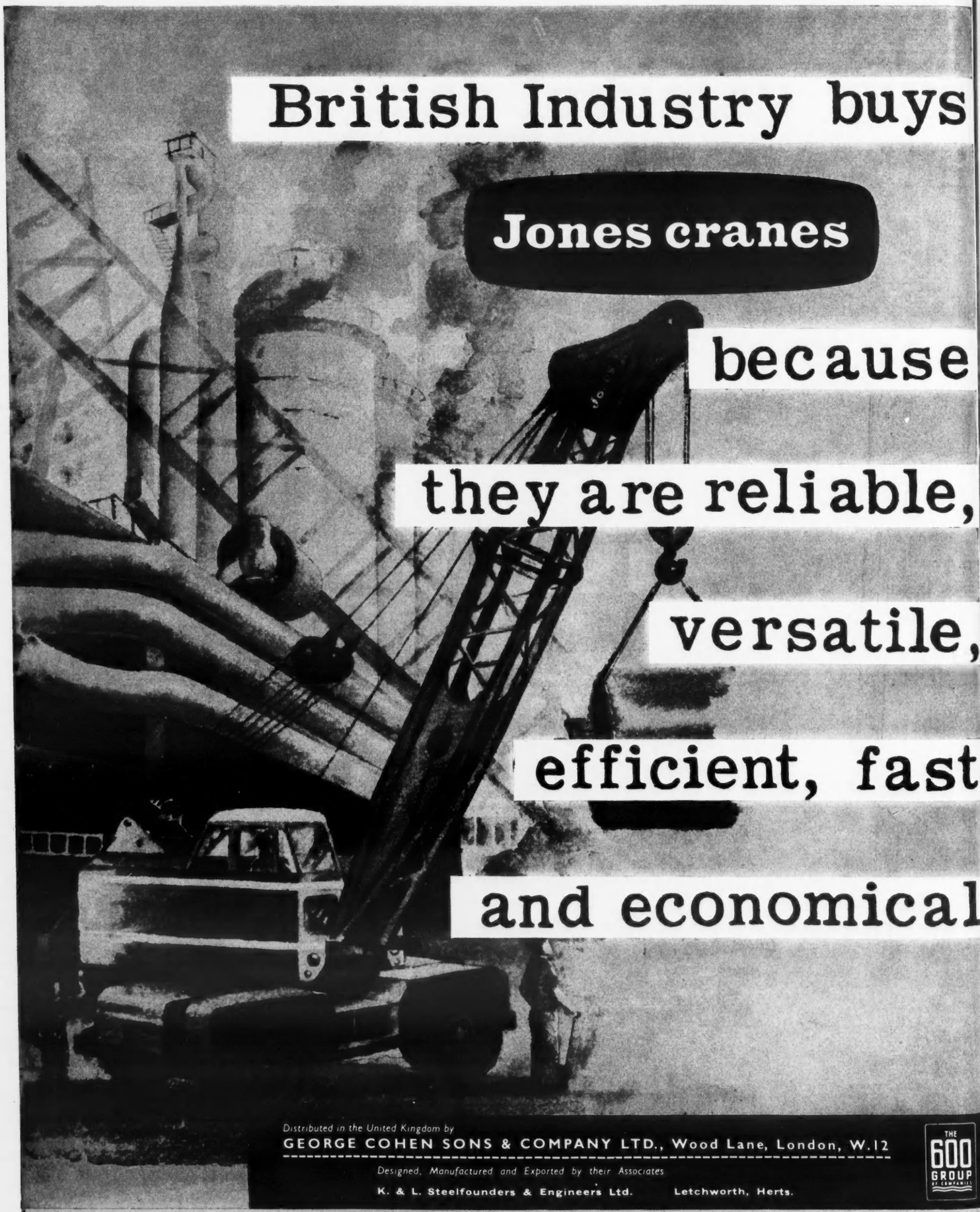

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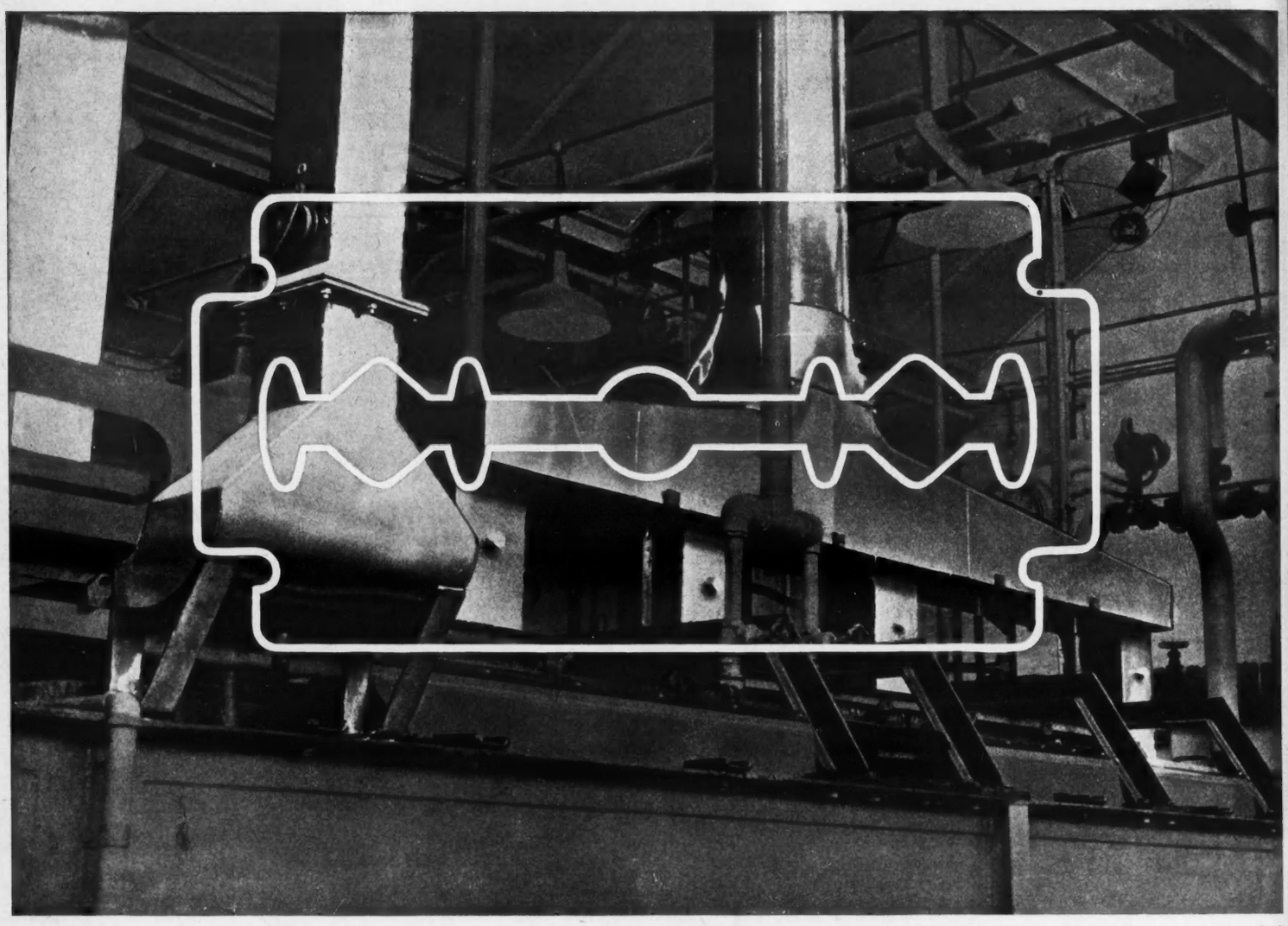

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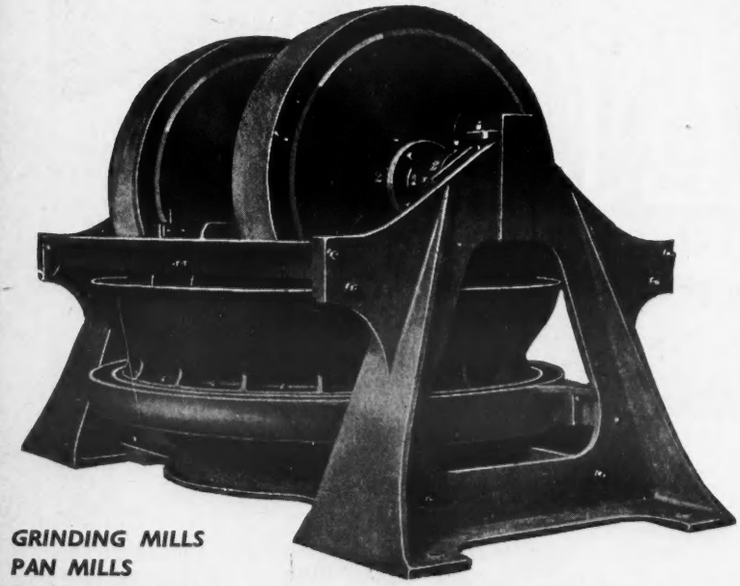

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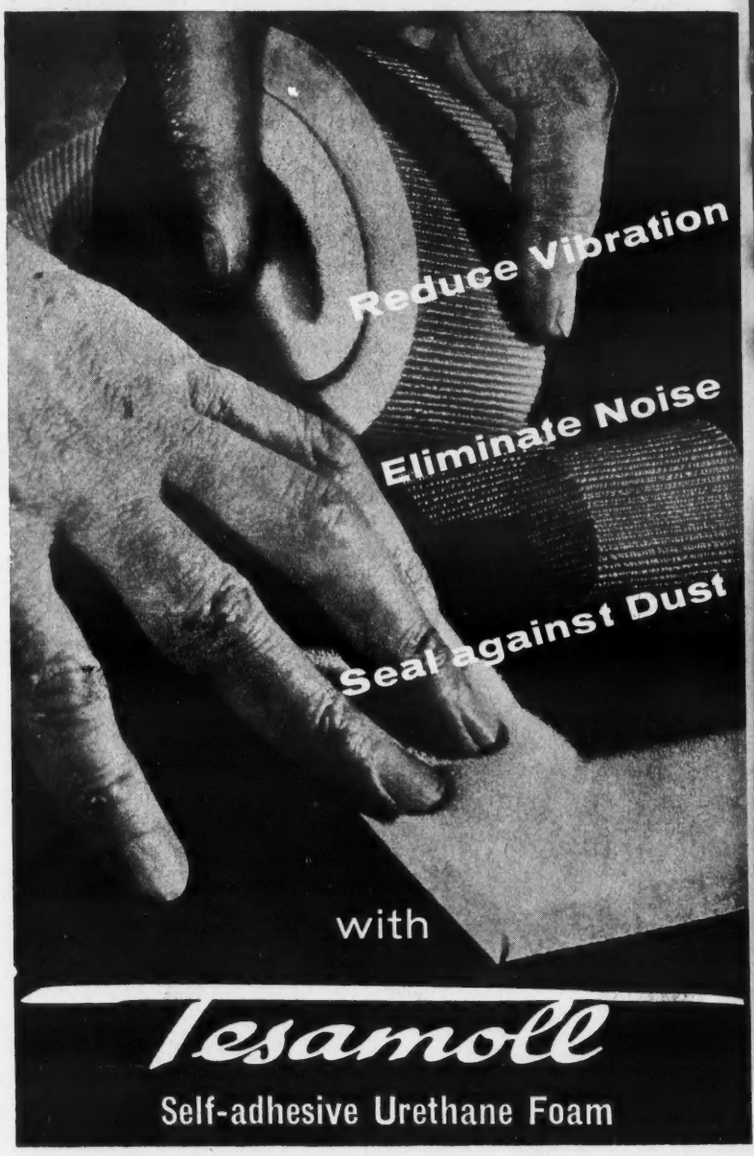

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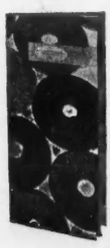

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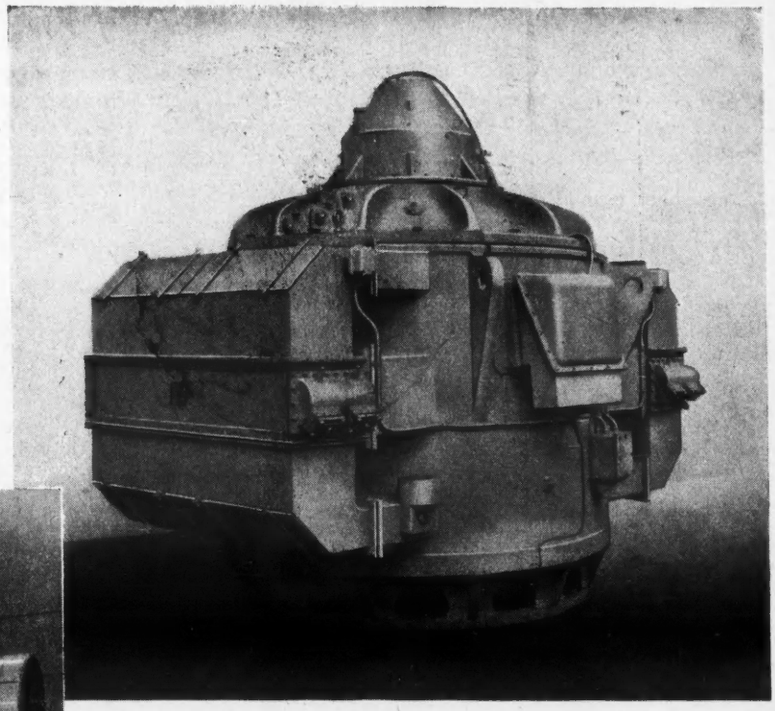
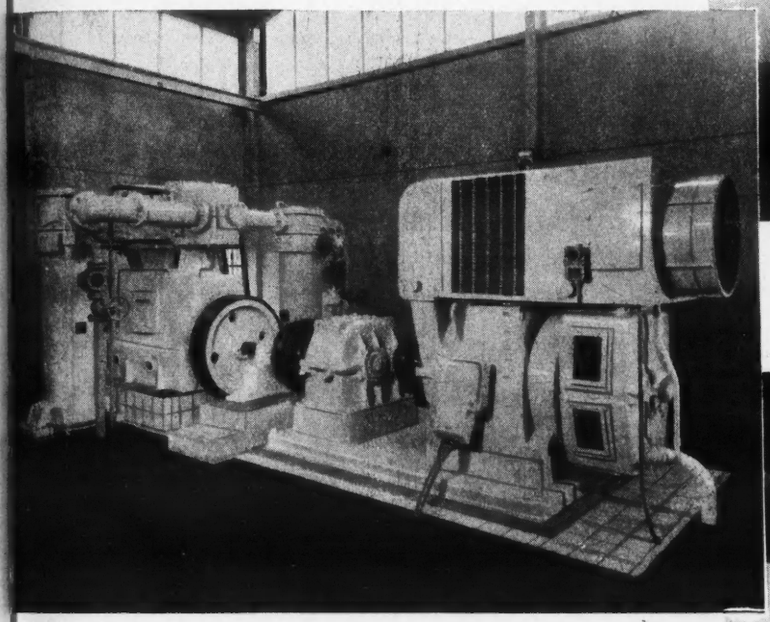
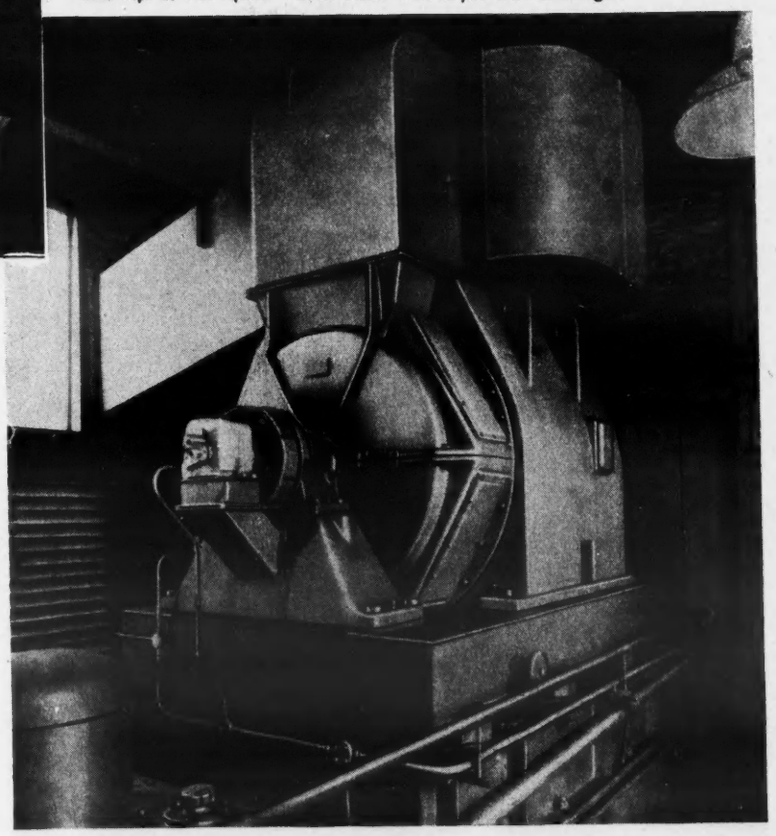


(Above) A "Trislot" motor of 1250 h.p., 595 r.p.m., 4000 volt, for pump drive. Closed air-circuit type with water cooler.



(Below) Slip-ring Induction Motor driving Sinter Fan (Barrow Iron Works). Rating 1380 h.p. at 743 r.p.m. Motor fitted with air/air heat exchanger.



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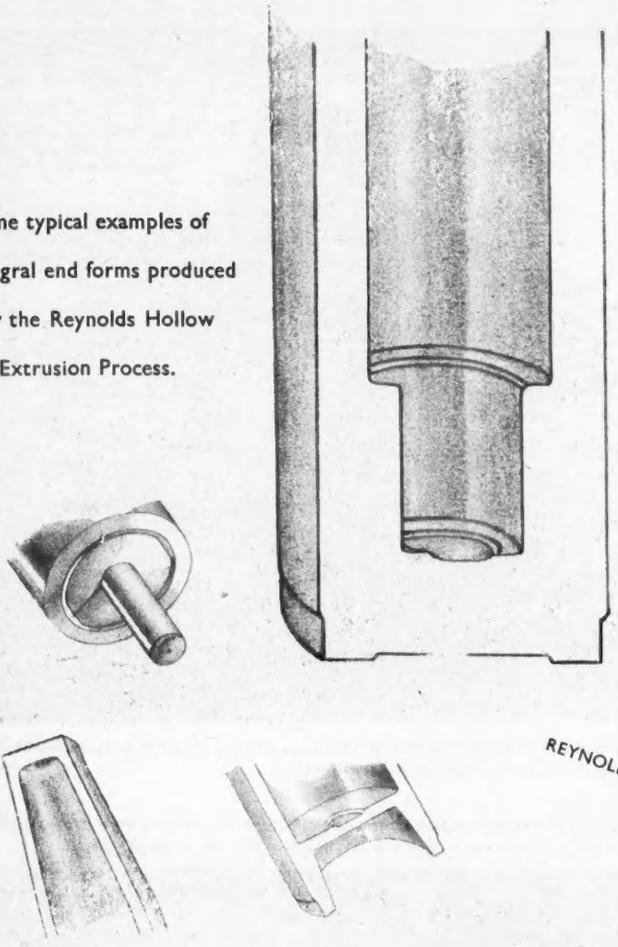

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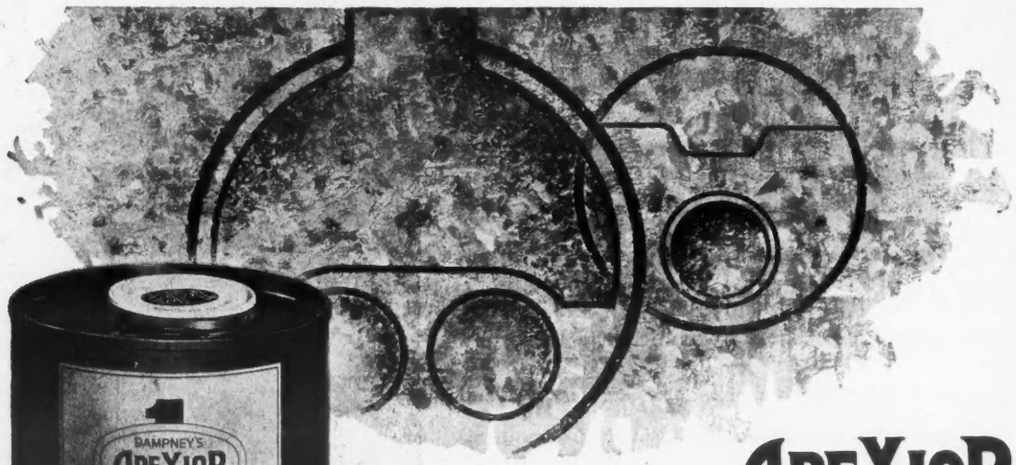

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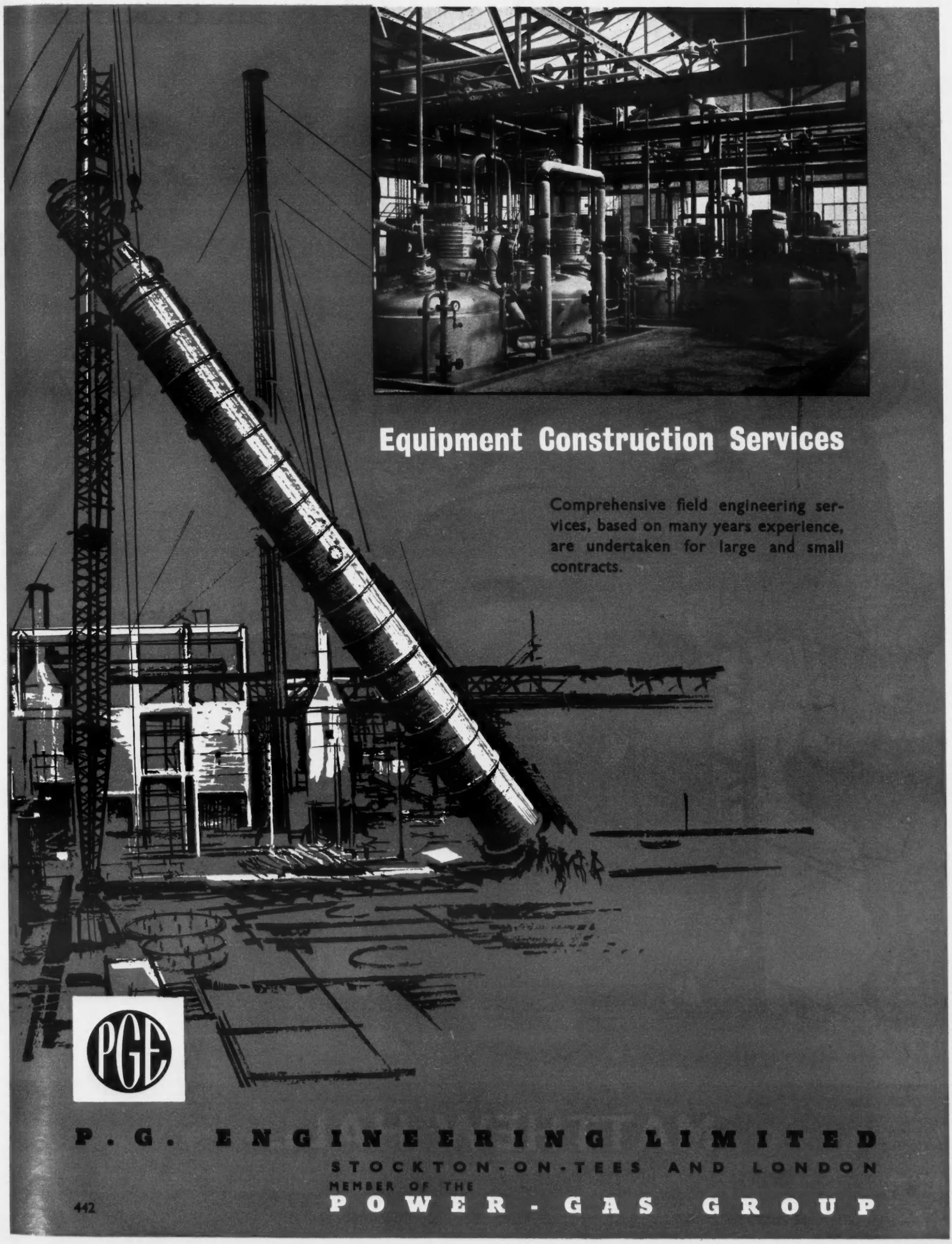
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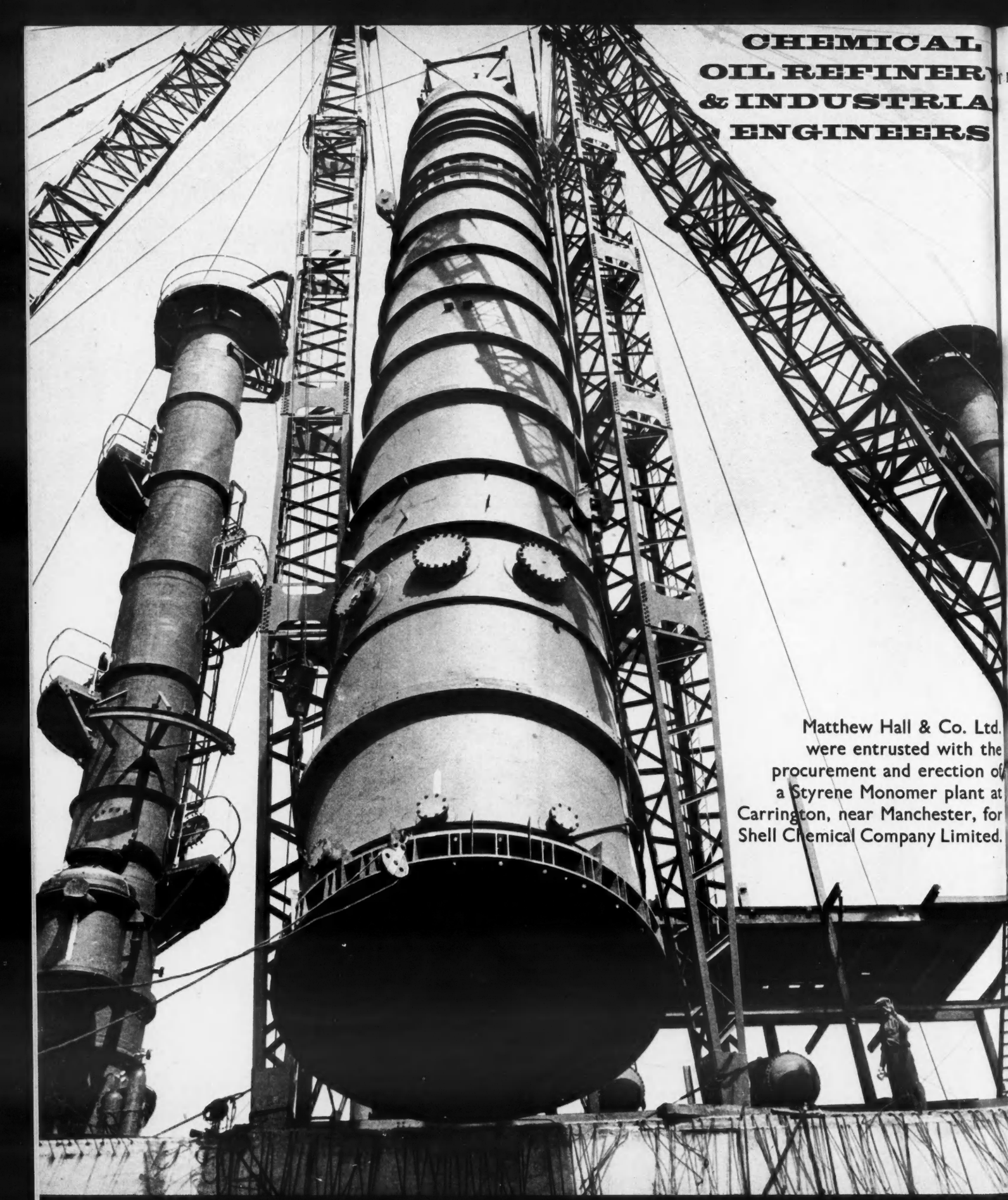

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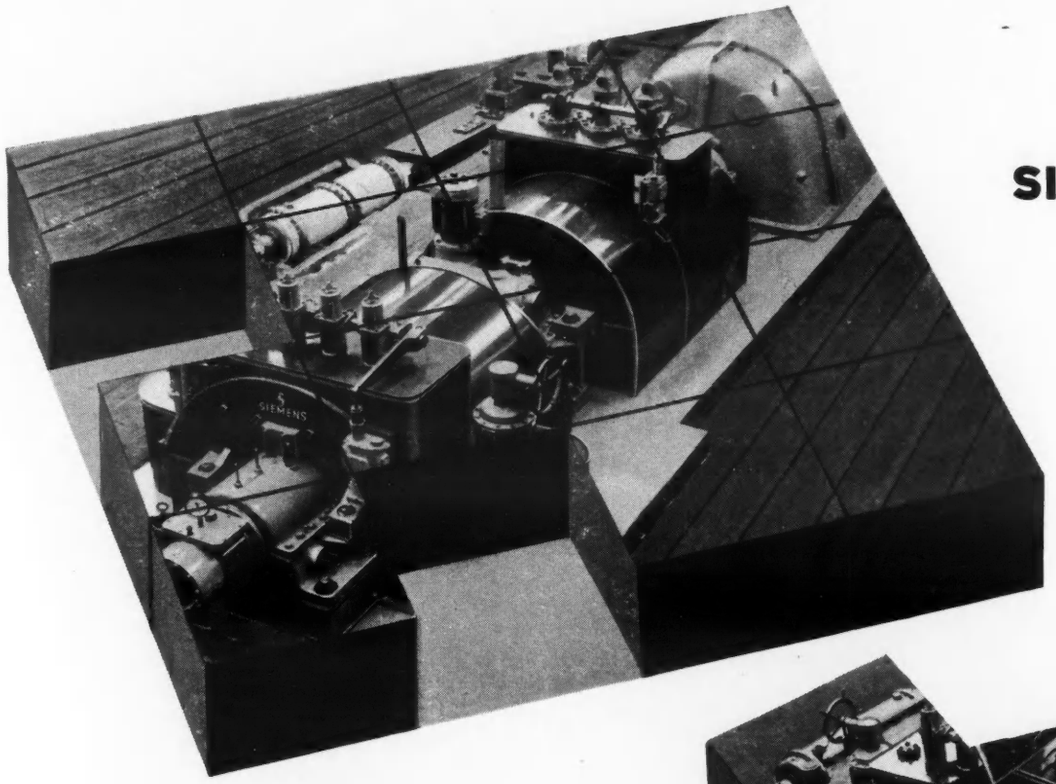

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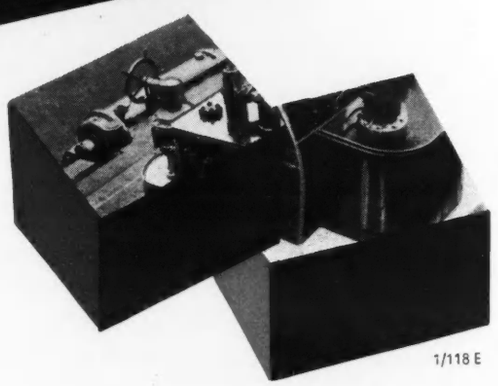

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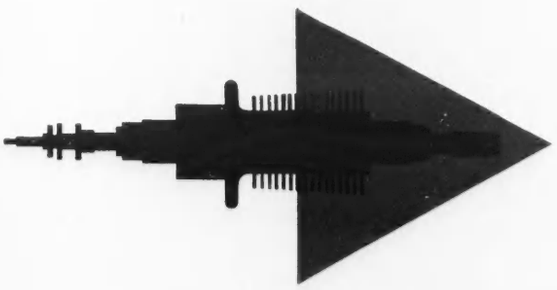

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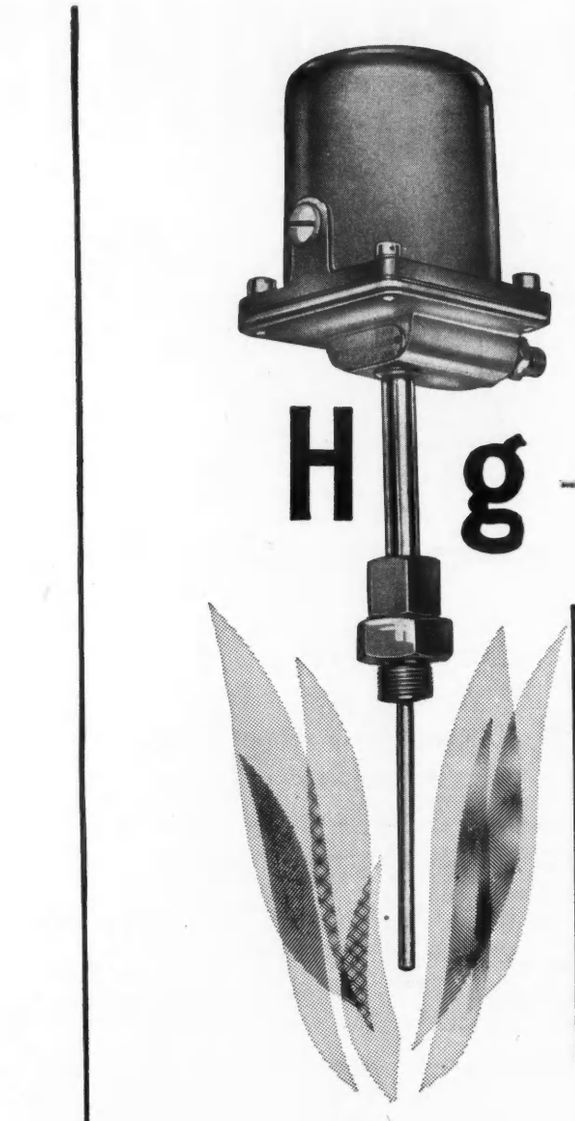

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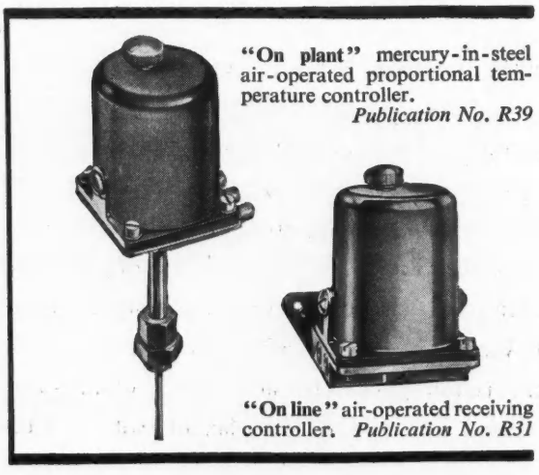

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High thermal response. Wide range of temperatures.
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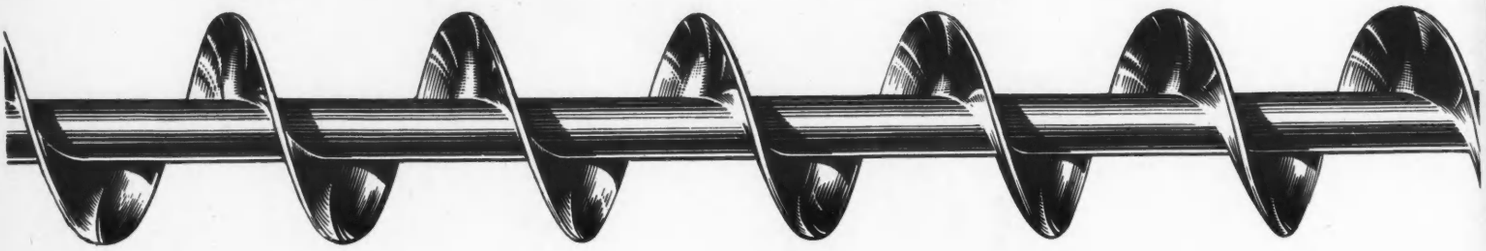

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Smooth, jointless surfaces, easy and constant passage of materials ; economical and trouble-free in operation — Helicoid Screw Conveyors have all these advantages ! Helicoid Flights are cold rolled from **continuous** strip, giving accuracy of pitch, without obstruction to the easy flow of granular, powdered or viscous materials. Designed in a wide variety of diameters and pitches according to the required capacity and nature of material conveyed, mounted on tubular or solid shafts, Helicoid Flights are supplied to makers of agricultural and industrial conveyors, elevators, mixers and borers. Superbly engineered from mild steel, Brass, Aluminium, stainless steel and in natural, painted, hard chrome, zinc sprayed or hot-dip galvanised finishes.

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Gelatine, Gypsum
Graphite
Iron Oxide
Lime, Limestone
Malt, Maize
Ores, Oats
Paper Pulp, Pumice
Quartz
Rice
Rubber, ground
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Vermiculite
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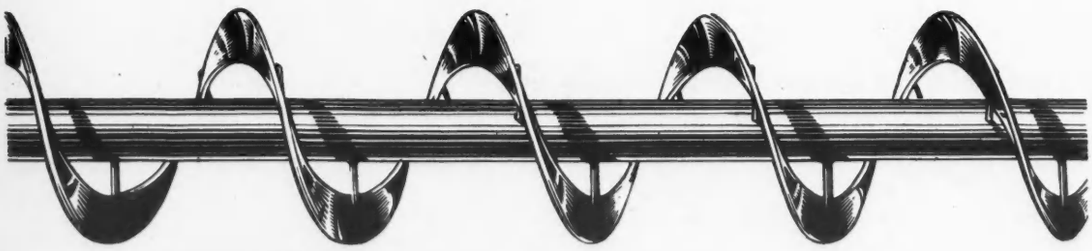
Wood, Wood Shavings
Zinc Oxide



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TIME AND AGAIN, broken press castings submitted to Barimar for repair by Scientific Welding, are returned to the owners better than new, thoroughly reinforced and good for indefinite service.

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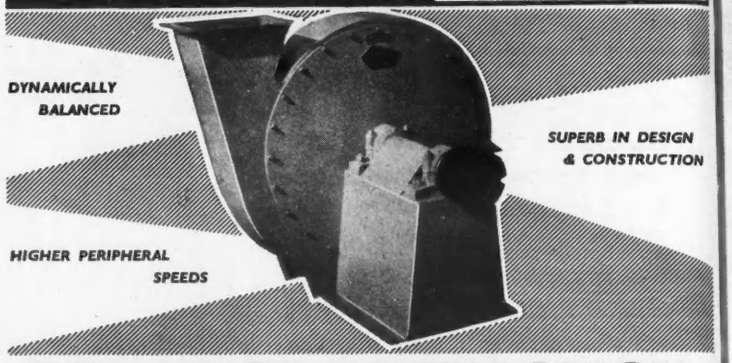

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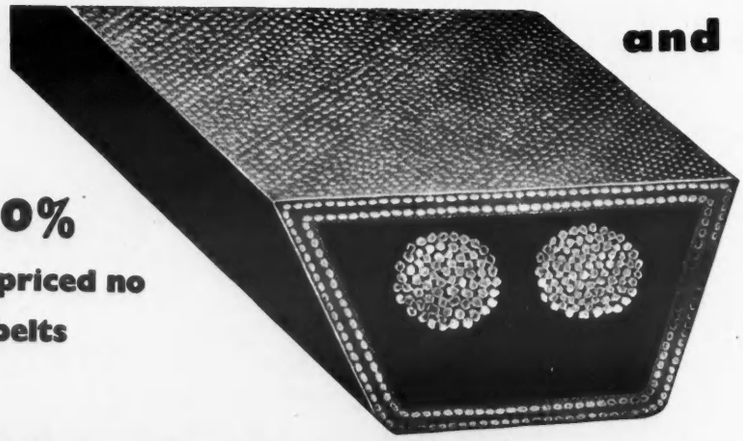

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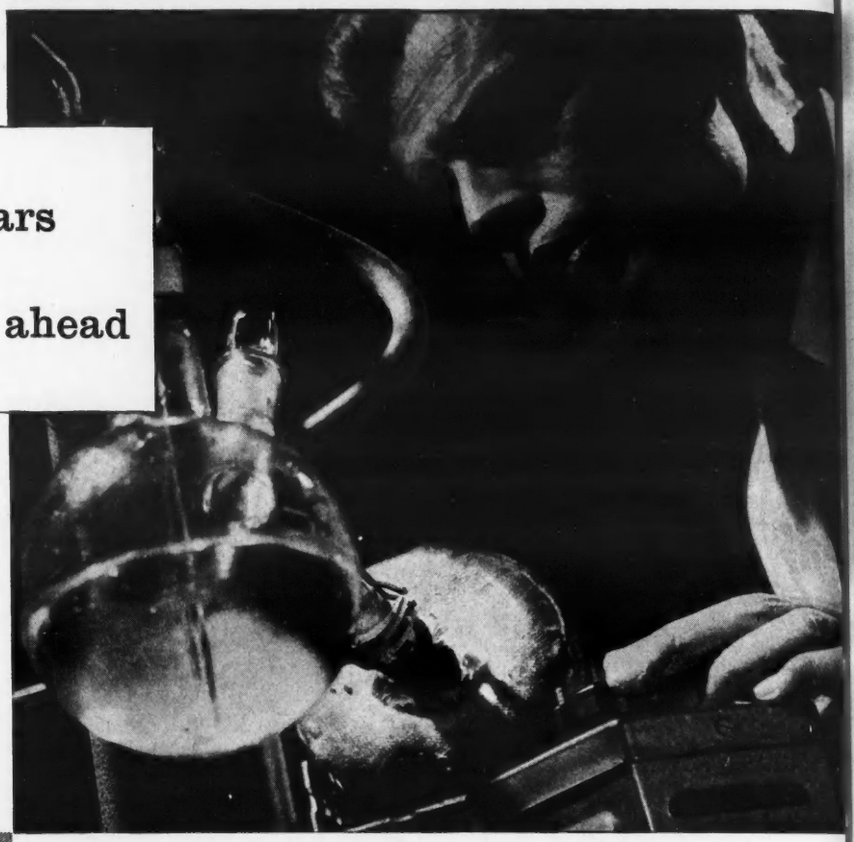

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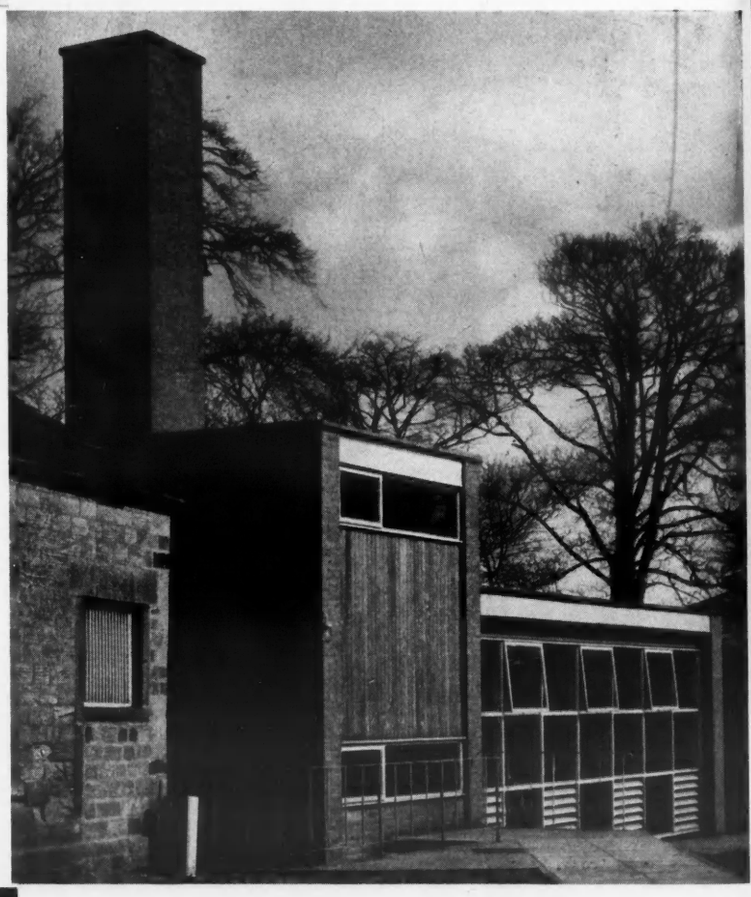

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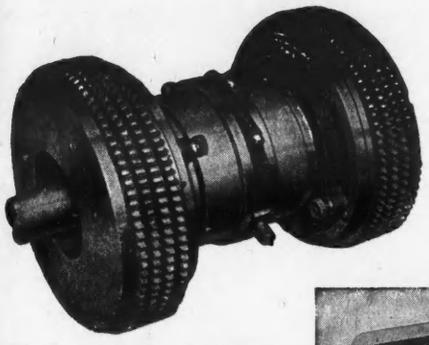

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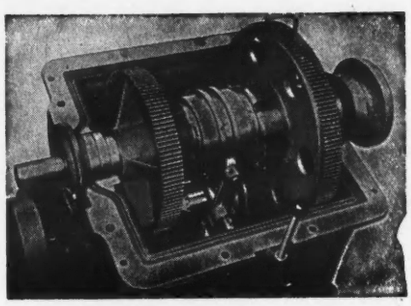

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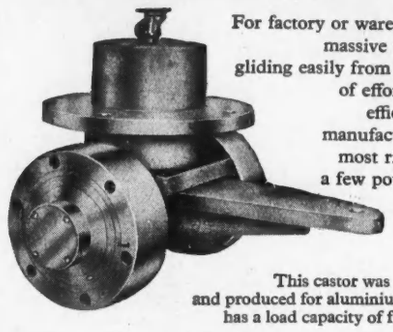

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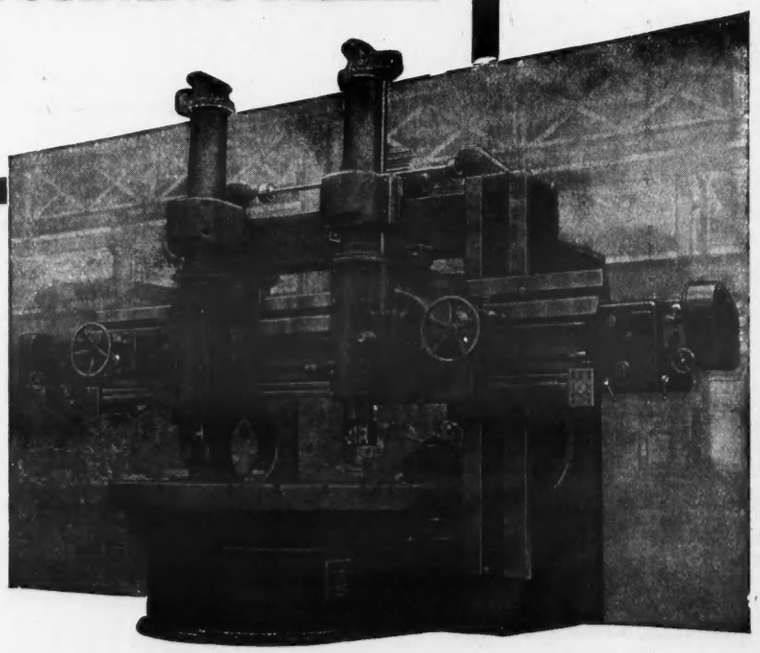

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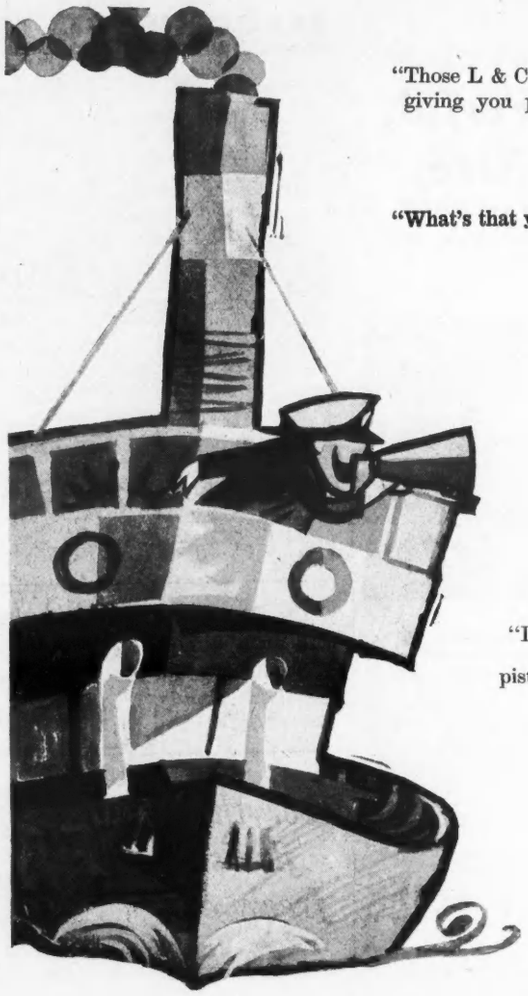

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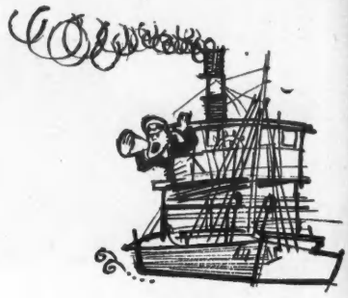

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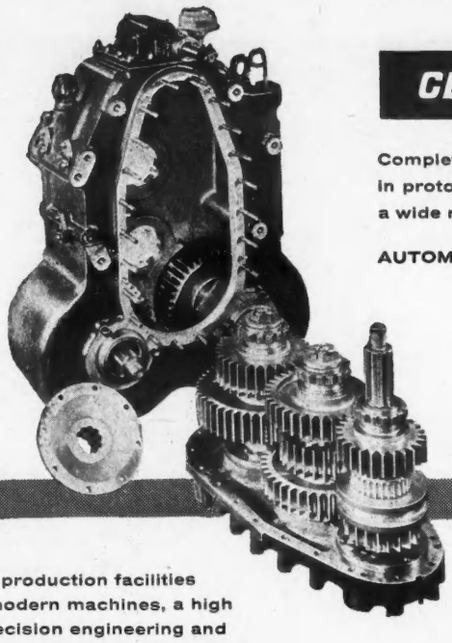

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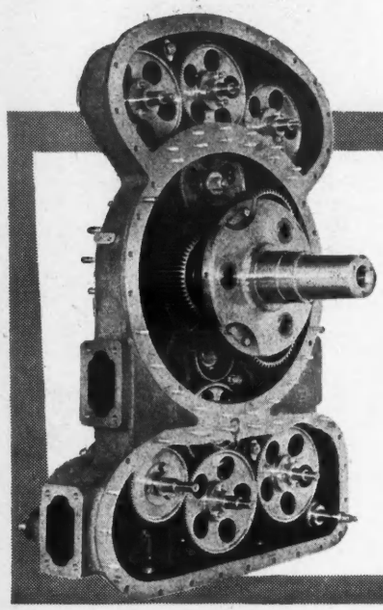

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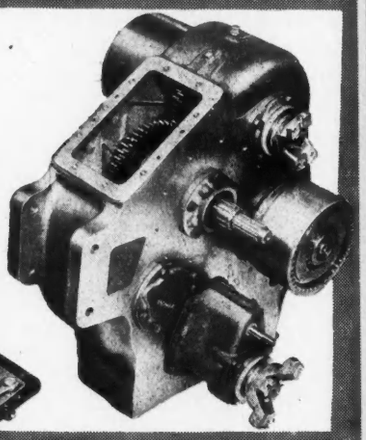

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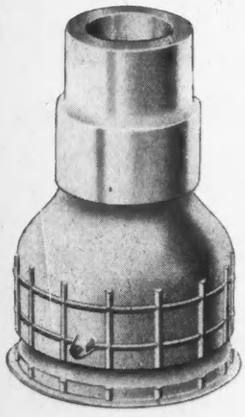

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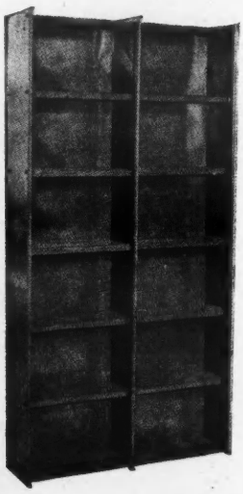

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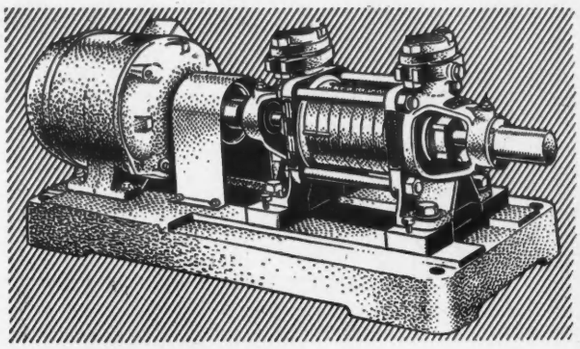

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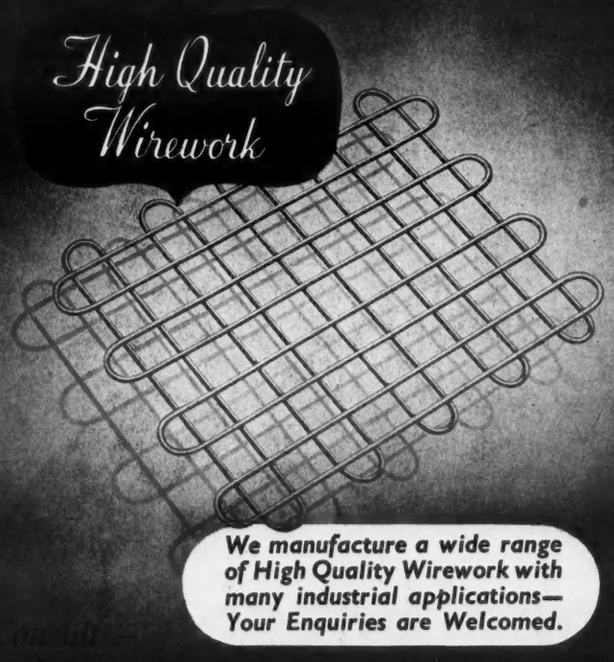

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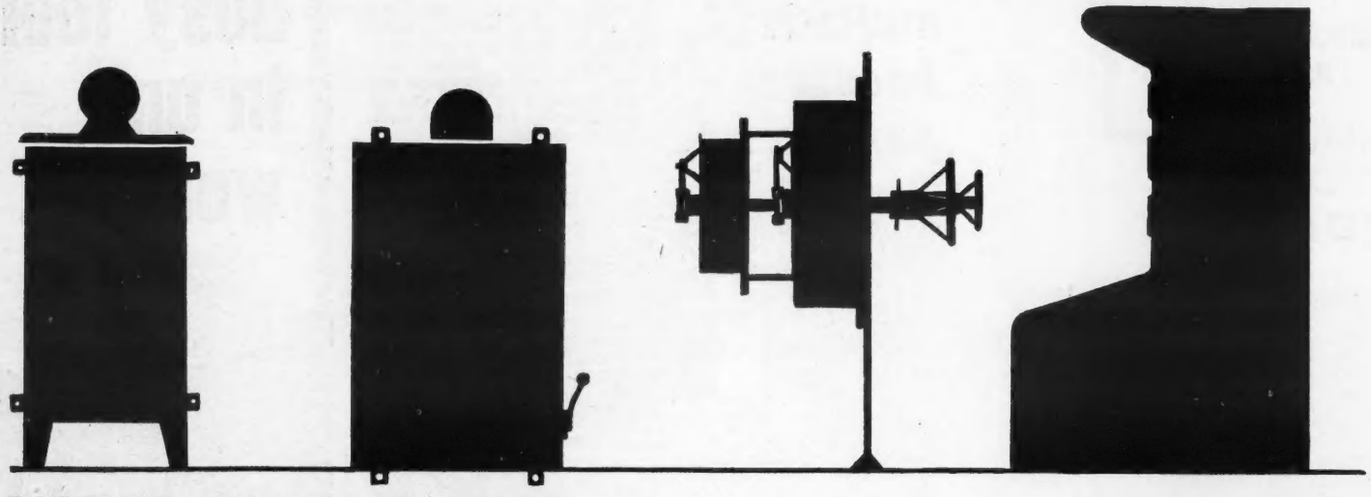

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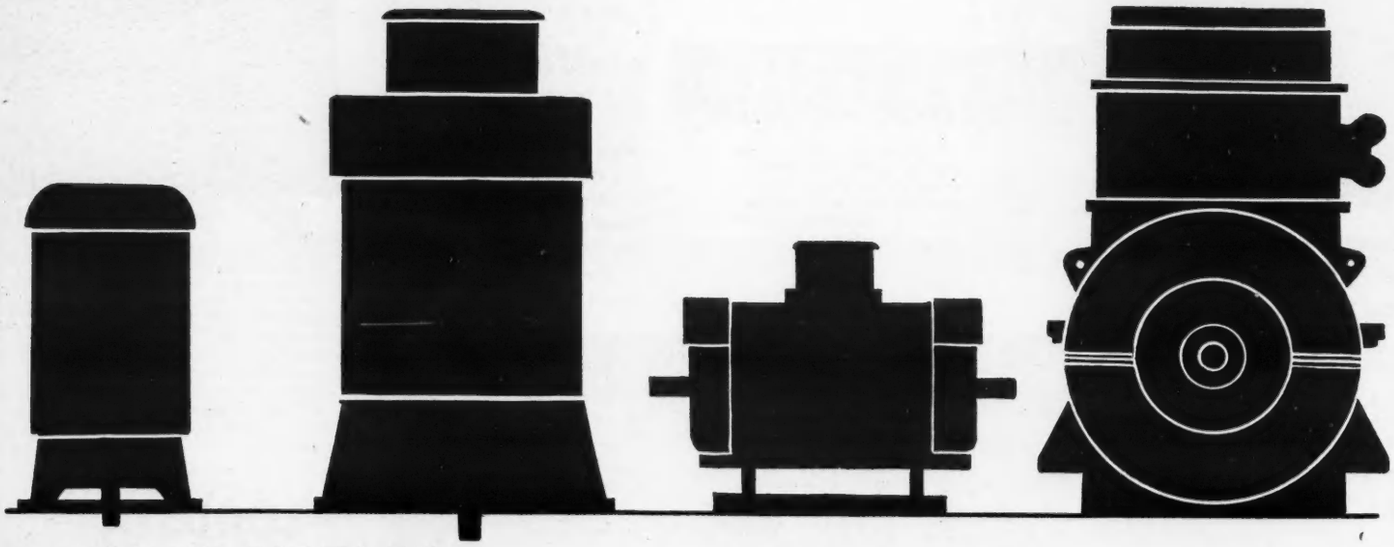

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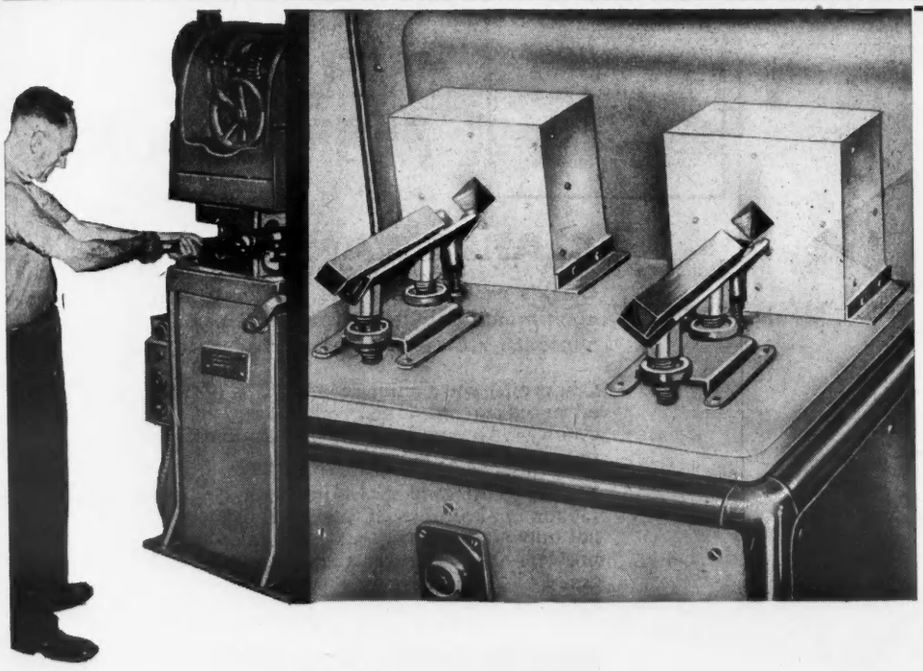

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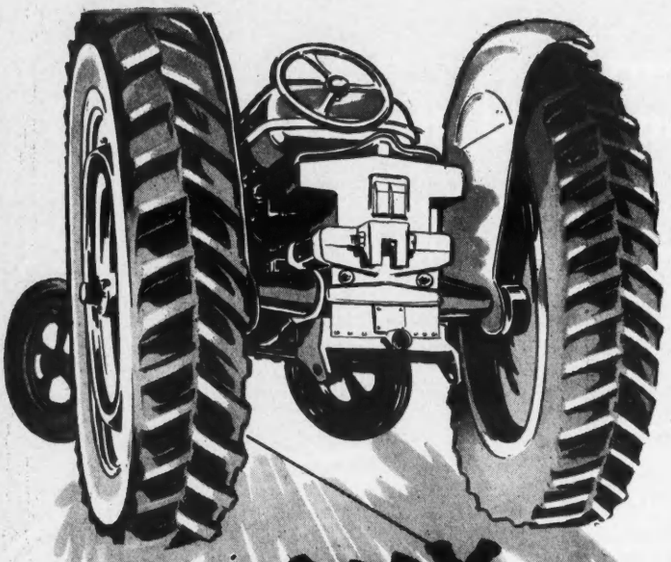

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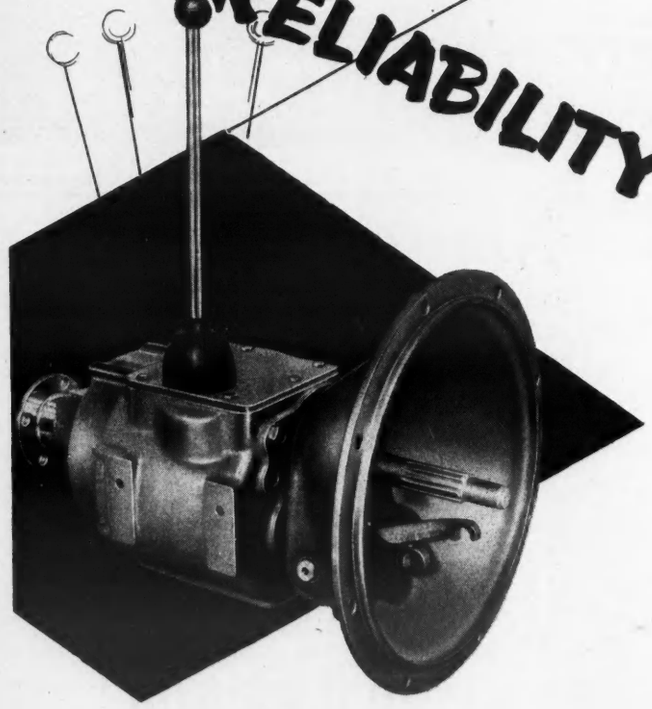

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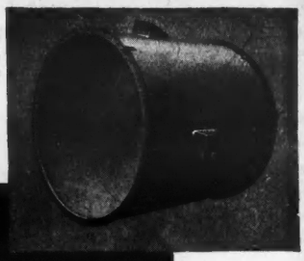
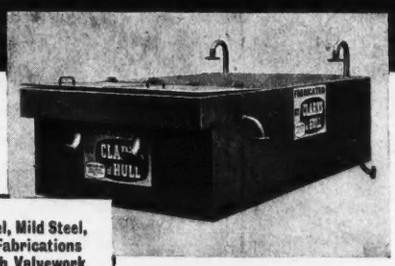


1,000 gall. kettle in ¼" copper. Lynx Quasi-arc welded.



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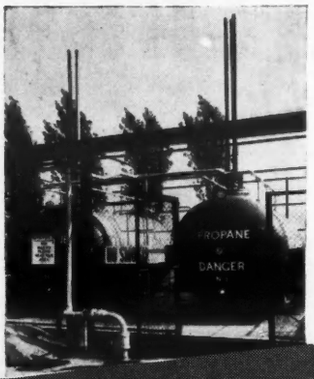

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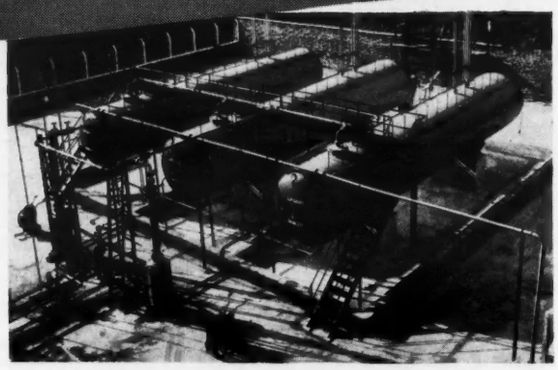
Vauxhall Motors Ltd. *Dunstable*
Vauxhall Motors Ltd. *Luton*

Installed and under construction



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All the 330 kV. strain insulators for the substations
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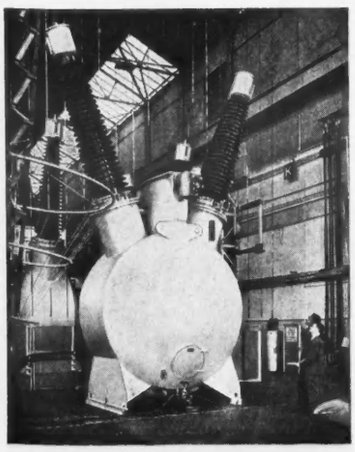

The illustrations show a complete 330 kV. bushing insulator and a 330 kV. circuit breaker, by courtesy of the B.T.H. Co.

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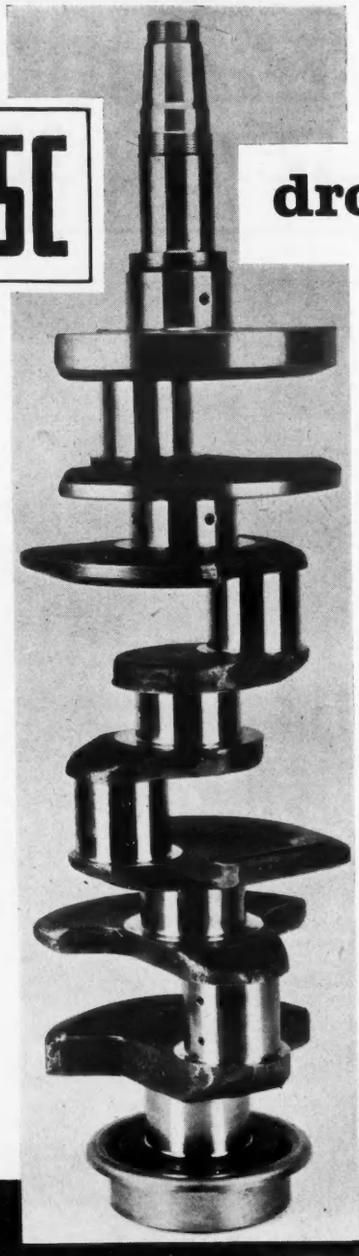

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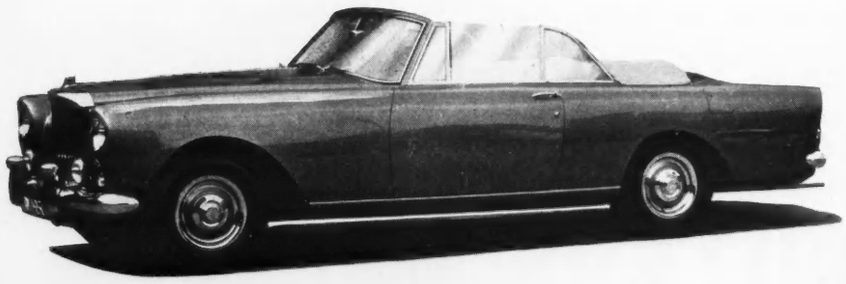

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KOLOK
POSITIVE LOCK WASHERS
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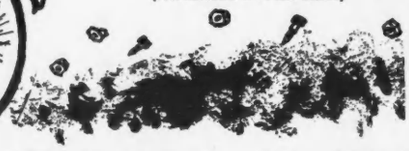

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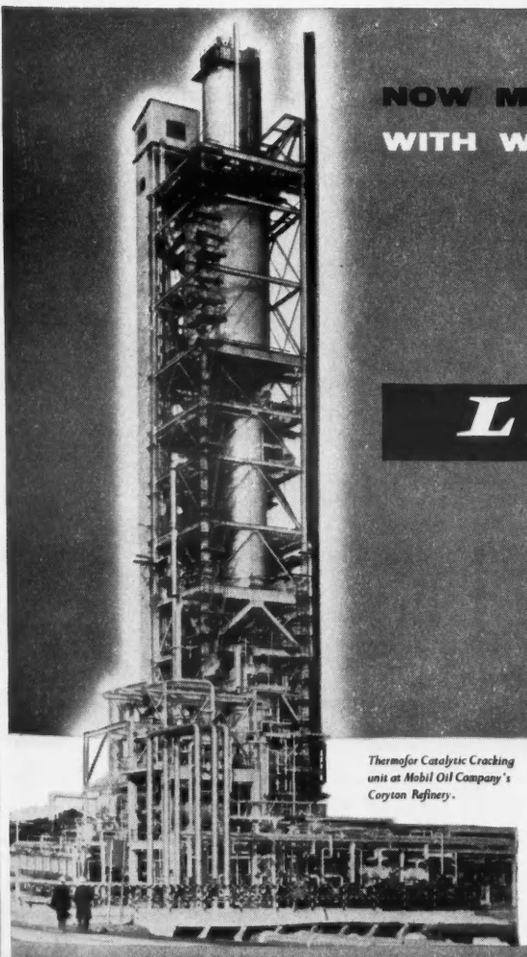

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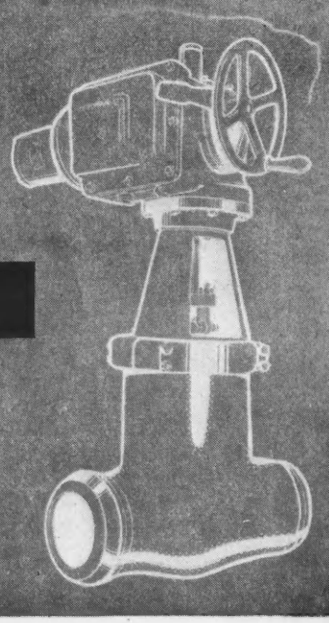

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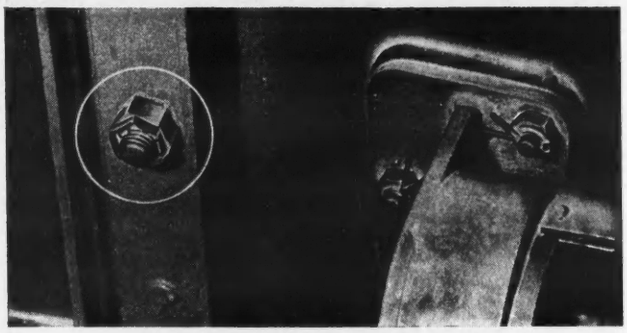

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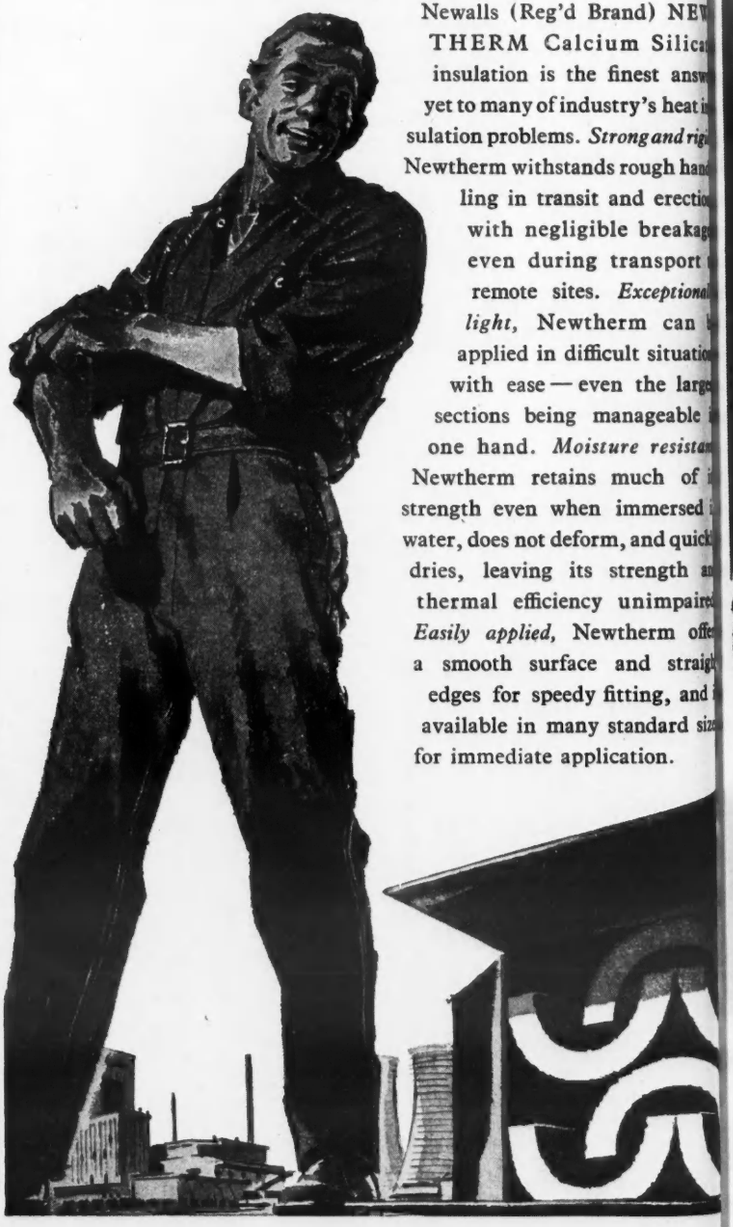

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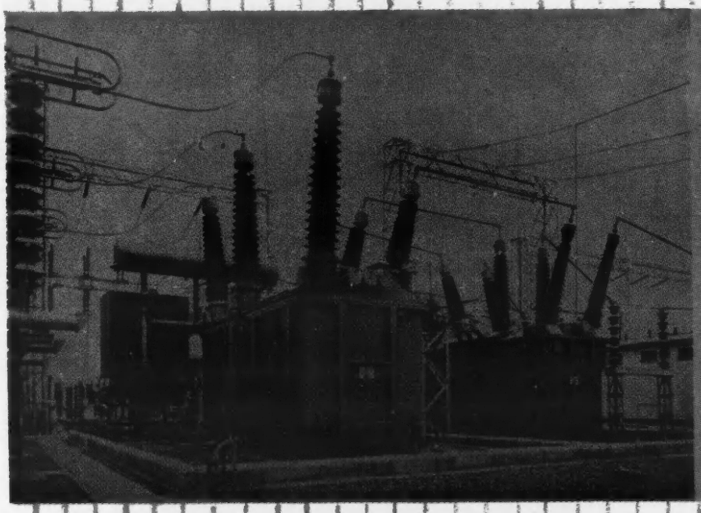
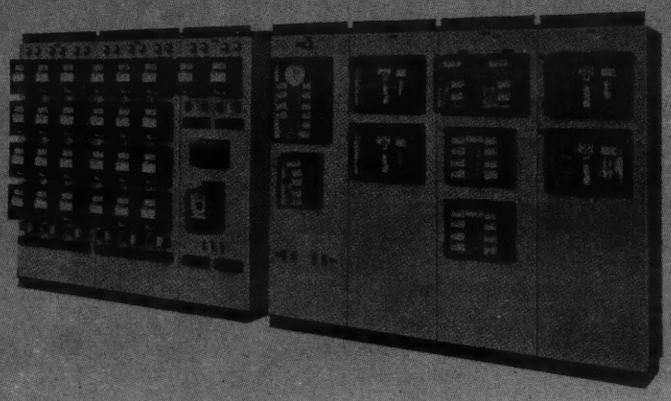


One of the two Ferranti 120,000 kVA 330/234 kV auto transformer and series booster installations at the Kitwe sub-station.

FERRANTI at KARIBA

Ferranti Summation Metering Panels for the Kariba Power Station.



The transformers and summation metering panels are for these sites.

TRANSFORMERS

All the sub-station transformers for the Kariba Hydro-Electric Scheme are being supplied by Ferranti Ltd. They comprise two 120,000 kVA, 330/234 kV 3-phase auto transformers with series boosters, eight 60,000 kVA, 330/88kV and four 60,000 kVA, 330/33 kV 3-phase double wound transformers. The transformer installations at Norton, Lusaka and Kitwe are complete. Work at Salisbury, Bulawayo and Sherwood is well advanced.

SUMMATION METERING

For the same scheme Ferranti Ltd. are supplying Summation Metering Equipment comprising: Precision grade integrating meters, Electro-mechanical summators, Printometer Demand Recorders and Suites of metering cubicles. These equipments will be used to meter six 100 MW generator sets at Kariba Power Station and also the supplies to the Transforming Stations at Kitwe, Norton, Salisbury, Lusaka, Sherwood and Bulawayo.

The consulting electrical and mechanical engineers are Messrs. Merz & McLellan.

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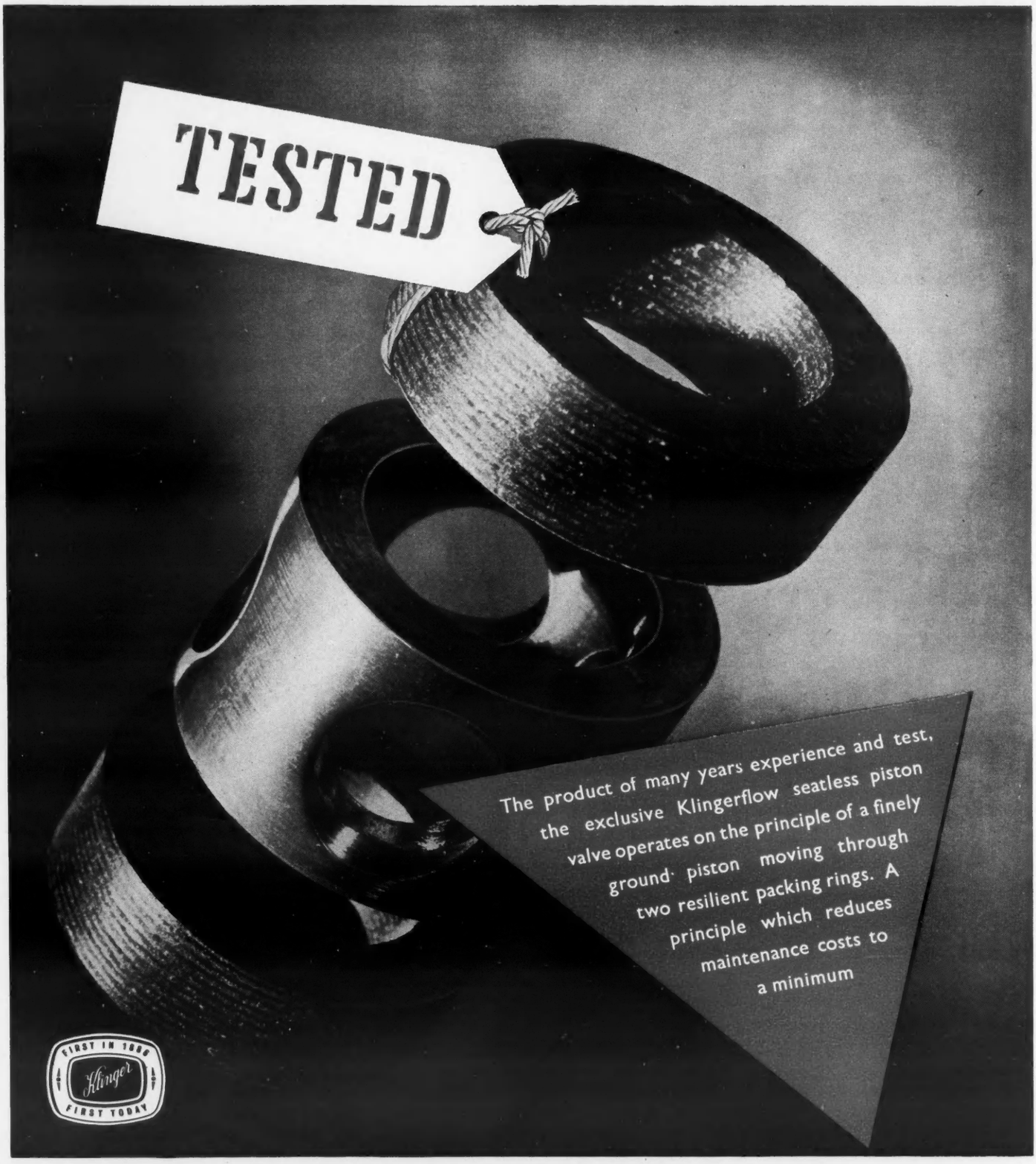
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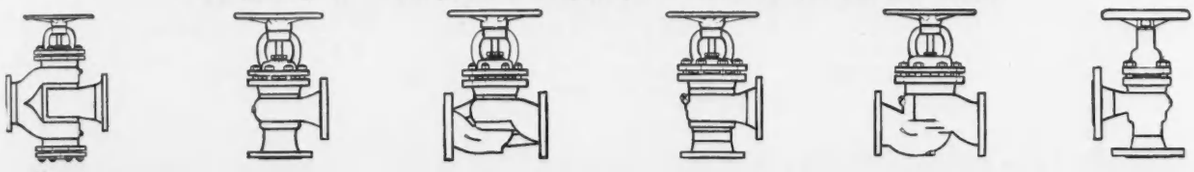

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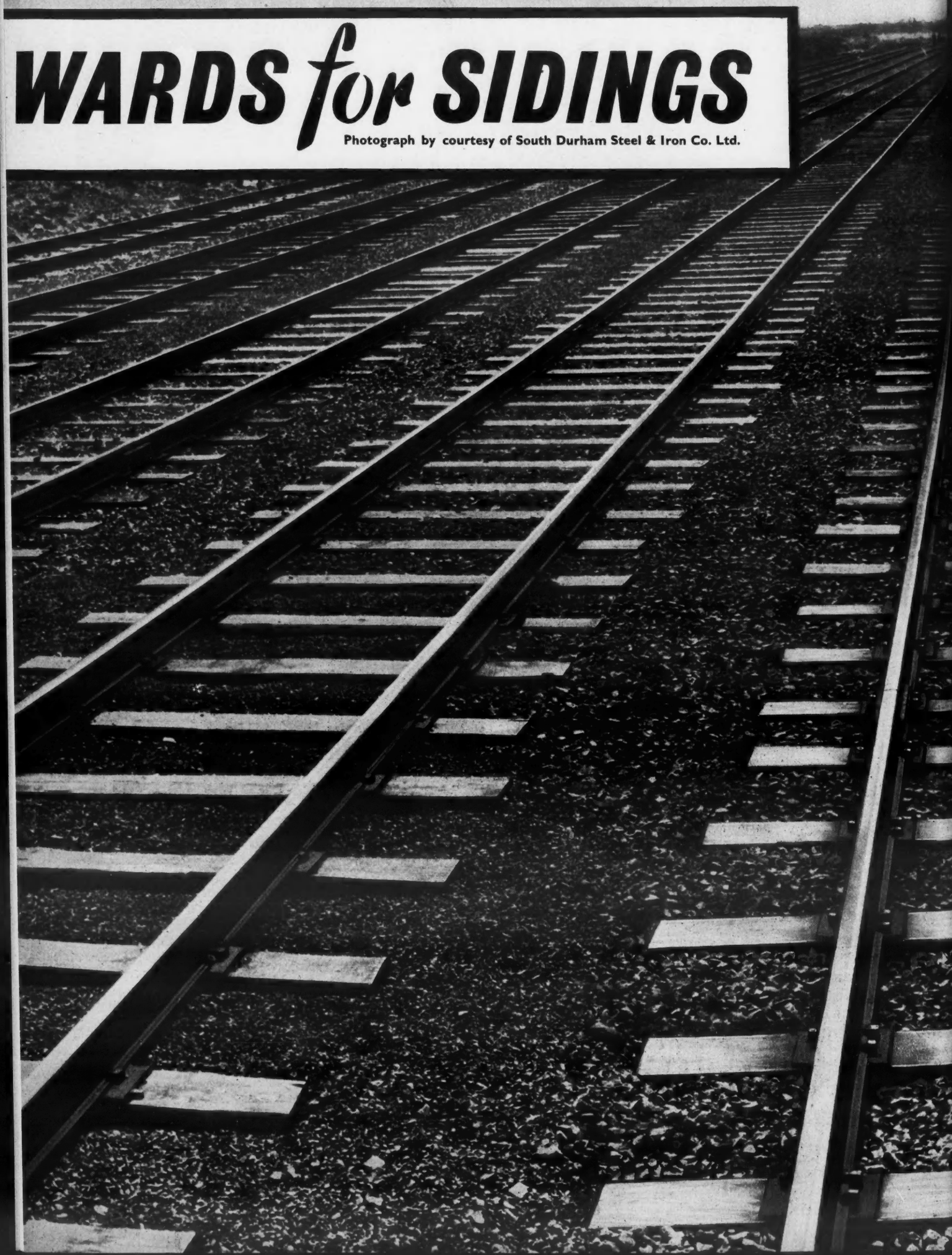
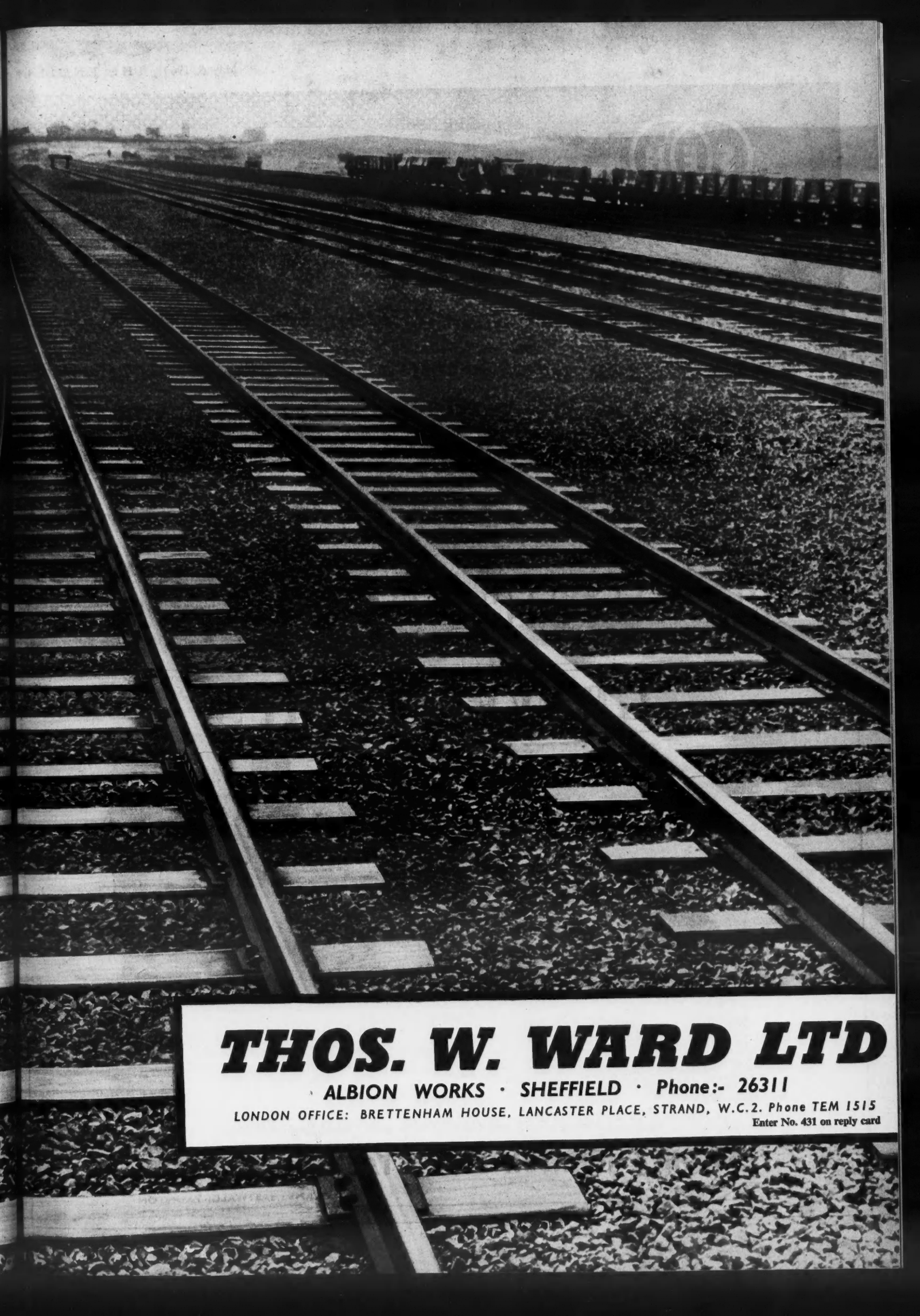


Photograph by courtesy of South Durham Steel & Iron Co. Ltd.



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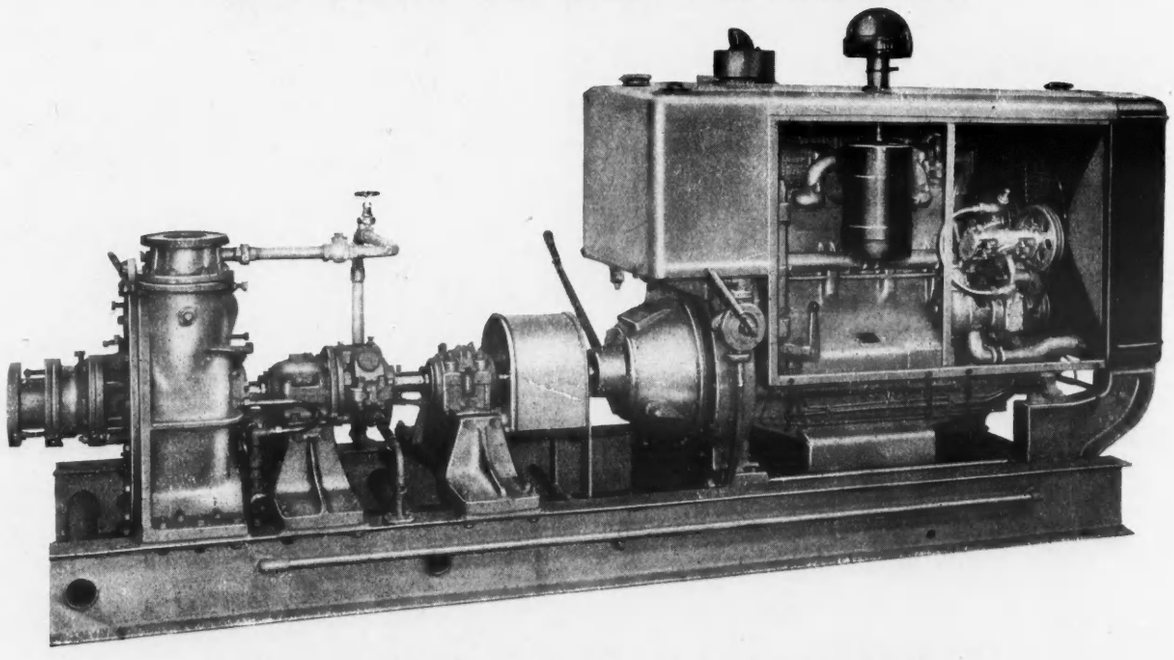

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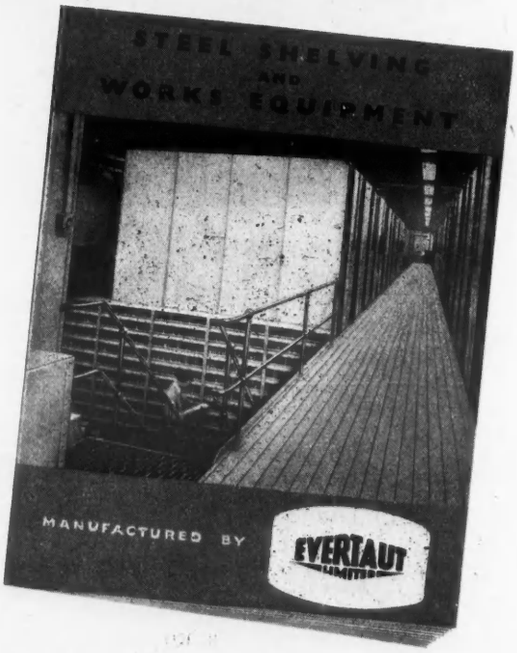

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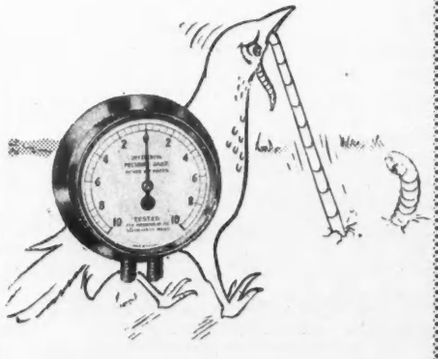

That's how it is just now —but, in the end, the thrush has the greater pull and if it were possible to connect their efforts to a P. & G. differential pressure gauge, the difference would be evident at once.

This P. & G. pressure gauge finds many applications in industry for measuring pressure differentials and is representative of the many P. & G. gauges and industrial instruments for special applications.

We shall be pleased to advise on your particular requirements.

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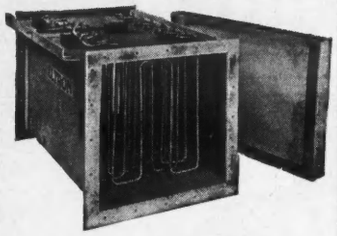

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is a push-BUTTON job

with the NEW CLYDE system

UNIFIED LECTRAMEK CONTROL SYSTEM

most efficient yet devised.

Considerable savings in initial cost and valuable boiler room space have been achieved by this new system of electrical control which works in conjunction with the Clyde Lectramek Soot Blower* - the original blower employing a uni-directional motor. Control is exercised from a small panel which indicates all essential information to the operator.

Further information is given in our publication No. CBL. 1954 which will be supplied on application.

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*Over 5,000 blowers of this type in use all over the world

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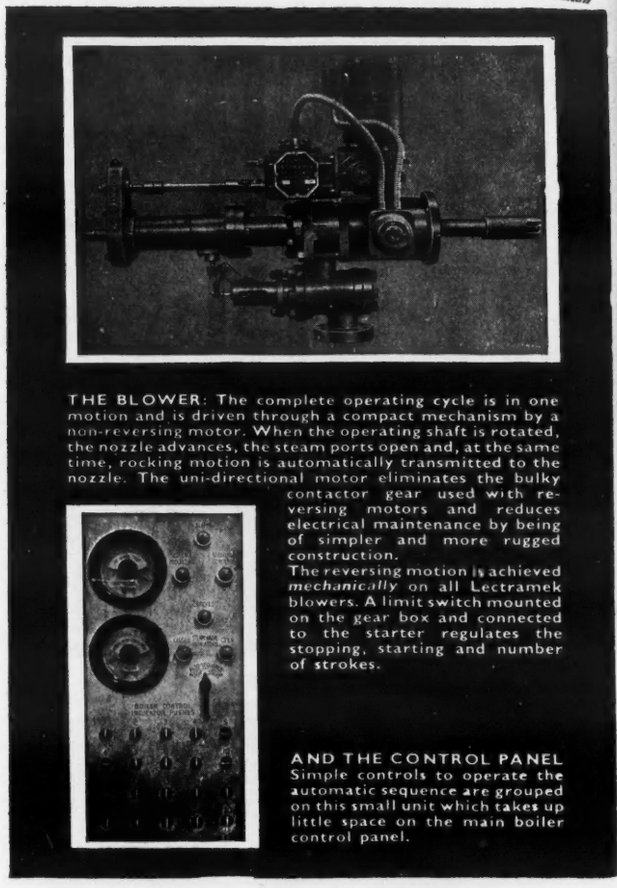

THE BLOWER: The complete operating cycle is in one motion and is driven through a compact mechanism by a non-reversing motor. When the operating shaft is rotated, the nozzle advances, the steam ports open and, at the same time, rocking motion is automatically transmitted to the nozzle. The uni-directional motor eliminates the bulky contactor gear used with reversing motors and reduces electrical maintenance by being of simpler and more rugged construction.
The reversing motion is achieved *mechanically* on all Lectramek blowers. A limit switch mounted on the gear box and connected to the starter regulates the stopping, starting and number of strokes.

AND THE CONTROL PANEL
Simple controls to operate the automatic sequence are grouped on this small unit which takes up little space on the main boiler control panel.

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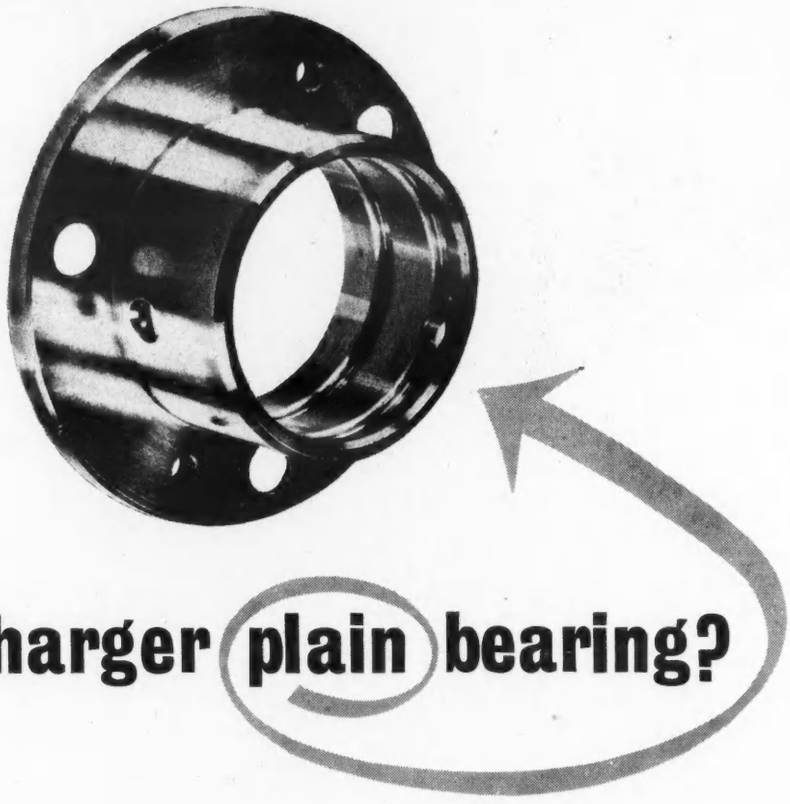

Turbocharger plain bearing?

This is a photograph of a turbocharger plain bearing taken after many thousands of running hours, its condition is almost

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The long trouble-free life of HSBT TURBOCHARGERS is in no small measure due to these plain bearings. Complete reliability, simplicity and effectiveness are features endorsed by the reports of many users. HSBT turbochargers are available for industrial and marine applications covering ENGINE RANGES OF 300 TO 5,000 H.P.

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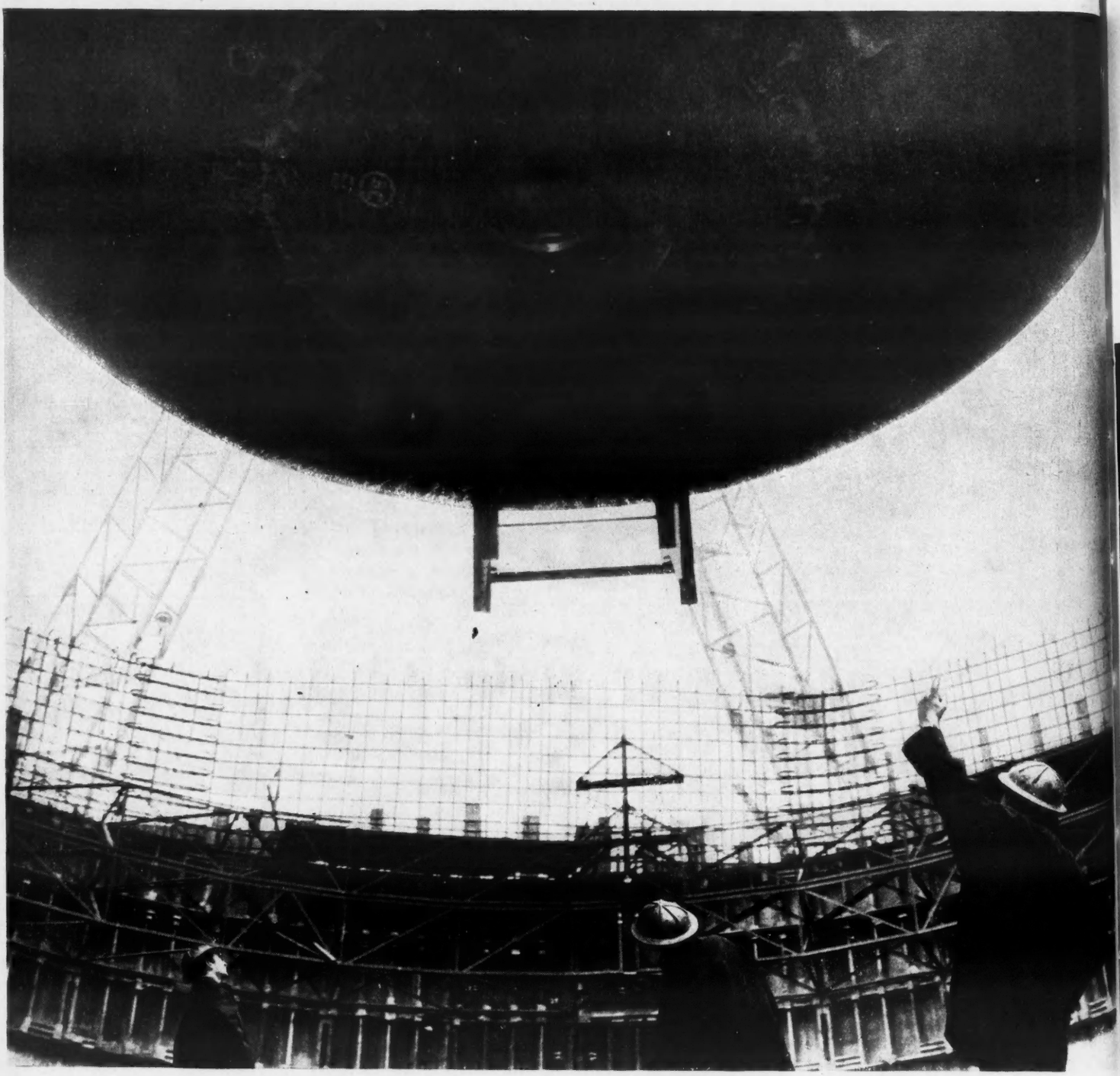

The base of the reactor shell at Latina about to be lifted into position. (Photo by courtesy of AGIP Nucleare, Nuclear Power Plant Company and Whessoe Ltd.)

Atom power comes to Italy—and Consett's 'Bearcomo' steel is at the heart of it

ITALY'S first nuclear power station, at Latina, is being built by a British consortium (The Nuclear Power Plant Company Ltd.) and using British equipment and materials. The vital reactor shell, made by Whessoe Ltd., is of Consett's 'Bearcomo' steel.

Consett developed 'Bearcomo' specially for atomic reactors. Steel for this purpose has to have very good 'creep' resistance at high temperatures, and 'notch' toughness at low temperatures—two characteristics normally thought incompatible. 'Bearcomo' combines them.

Consett has provided special steels for Britain's own nuclear power programme. The reactors at Bradwell, Chapelcross and Calder Hall are housed in shells made of 'Bearcomo' plates. 'Bearcomo' was awarded a Gold Medal at the Brussels International Fair last year.

To keep its commanding competitive position in the field of steel plate, Consett is building a £14 million 'four-high' plate mill, which will be the most up-to-date in the world. Work on it is already well advanced: foundations are ready for the mill-stand itself and the great shears; the cooling tables and some of the transfer banks are finished, and the overhead cranes are installed. It will be a mighty addition to Britain's industrial power.

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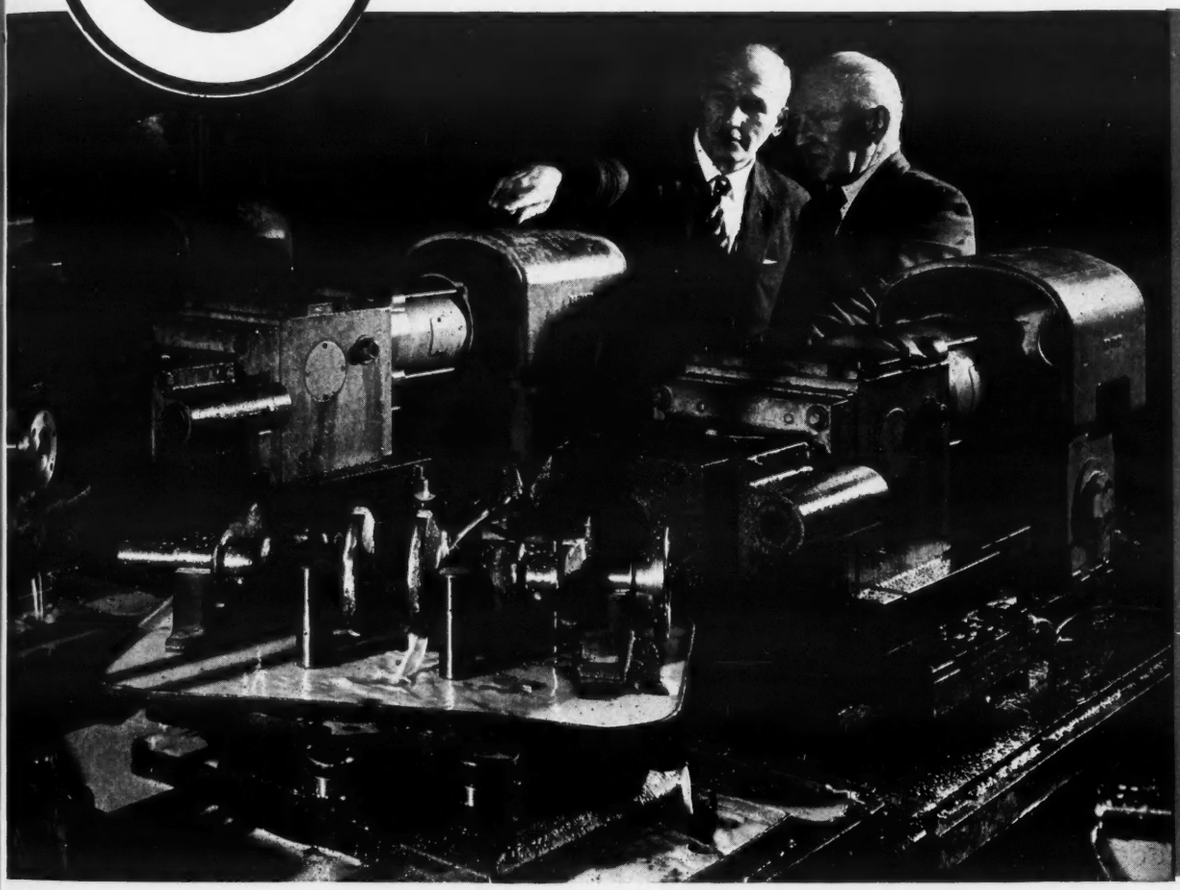

Mr. W. H. Homan-Berry, Austin's Assistant chief planning engineer says:

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Which is why more and more British industries are turning to Regal Oils (R & O) for high quality performance and complete dependability.

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Regal Oils (R & O) contain a rust inhibitor which 'plates out' on metal surfaces, forming a tenacious film that is impervious to rusting action of moisture and water. This eliminates the damage so often caused by rust.

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Regal Oils (R & O) cling to metal surfaces and penetrate between closely fitted bearing surfaces, giving adequate lubrication. This way wear is minimised.

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Regal Oils (R & O) are processed so that they are highly resistant to foaming. This characteristic is improved by additive treatment.

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Regal Oils (R & O) are manufactured in different viscosity grades to meet every operating condition and give excellent performance at both high and low temperatures.
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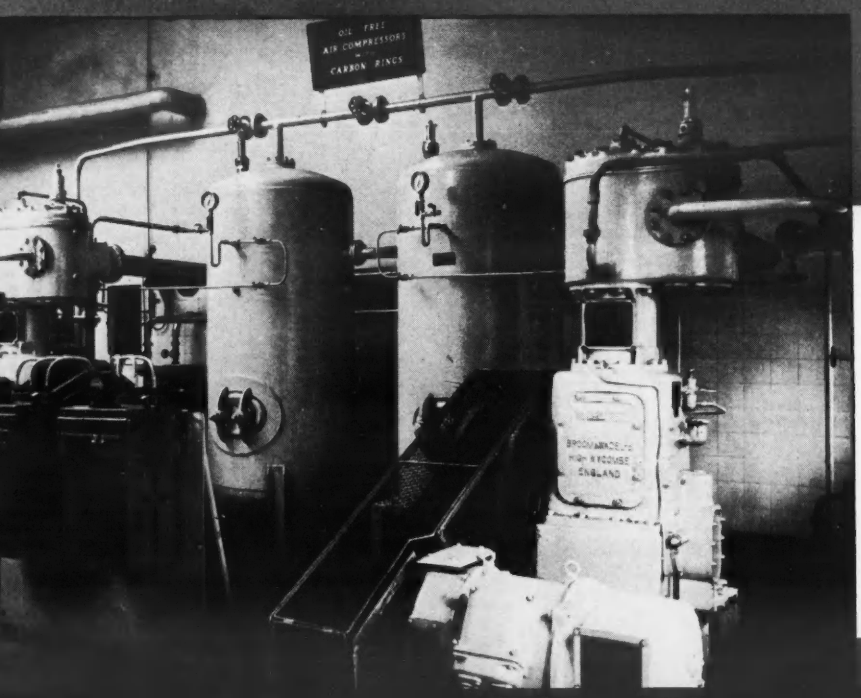

Two "BROOMWADE" TYPE S Dry Cylinder Carbon Ring Air Compressors delivering OIL-FREE AIR, installed at the brewery of Messrs Ind Coope Ltd., Alloa.

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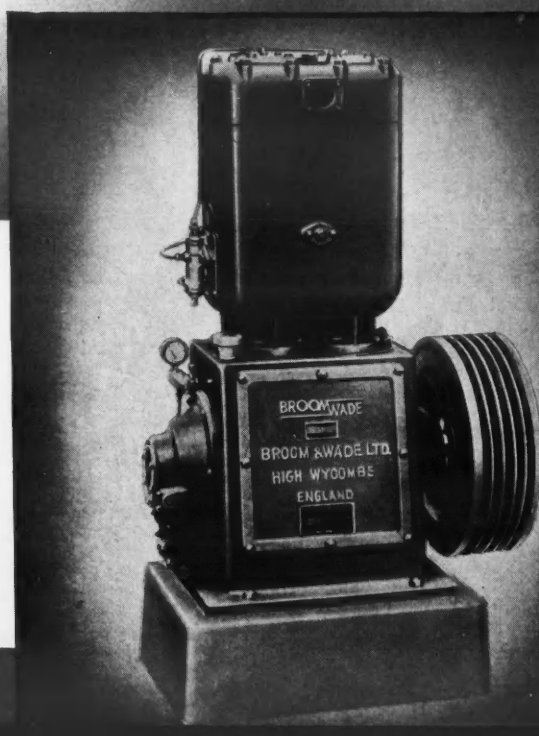

"BROOMWADE" TYPE C660 Dry Cylinder Carbon Ring Air Compressor delivering 100 c.f.m. of OIL-FREE AIR at 100 p.s.i.

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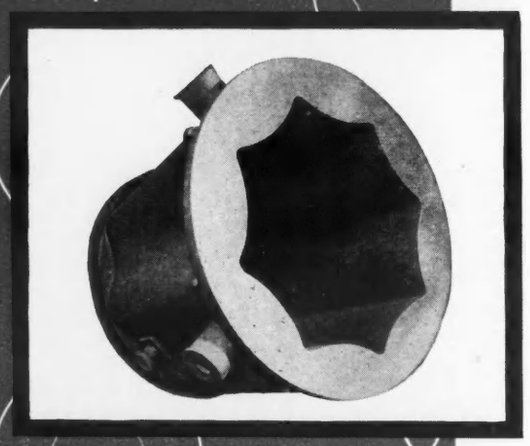
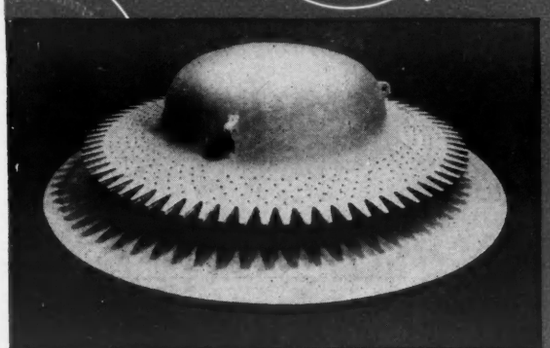


DISTINGTON HEAVY CASTINGS



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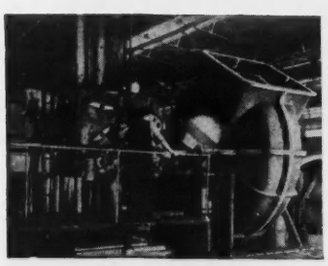

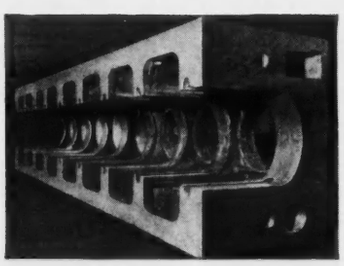

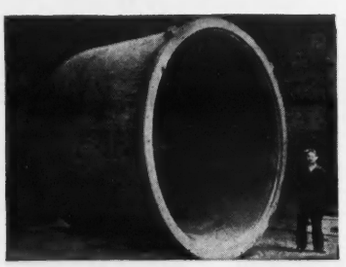

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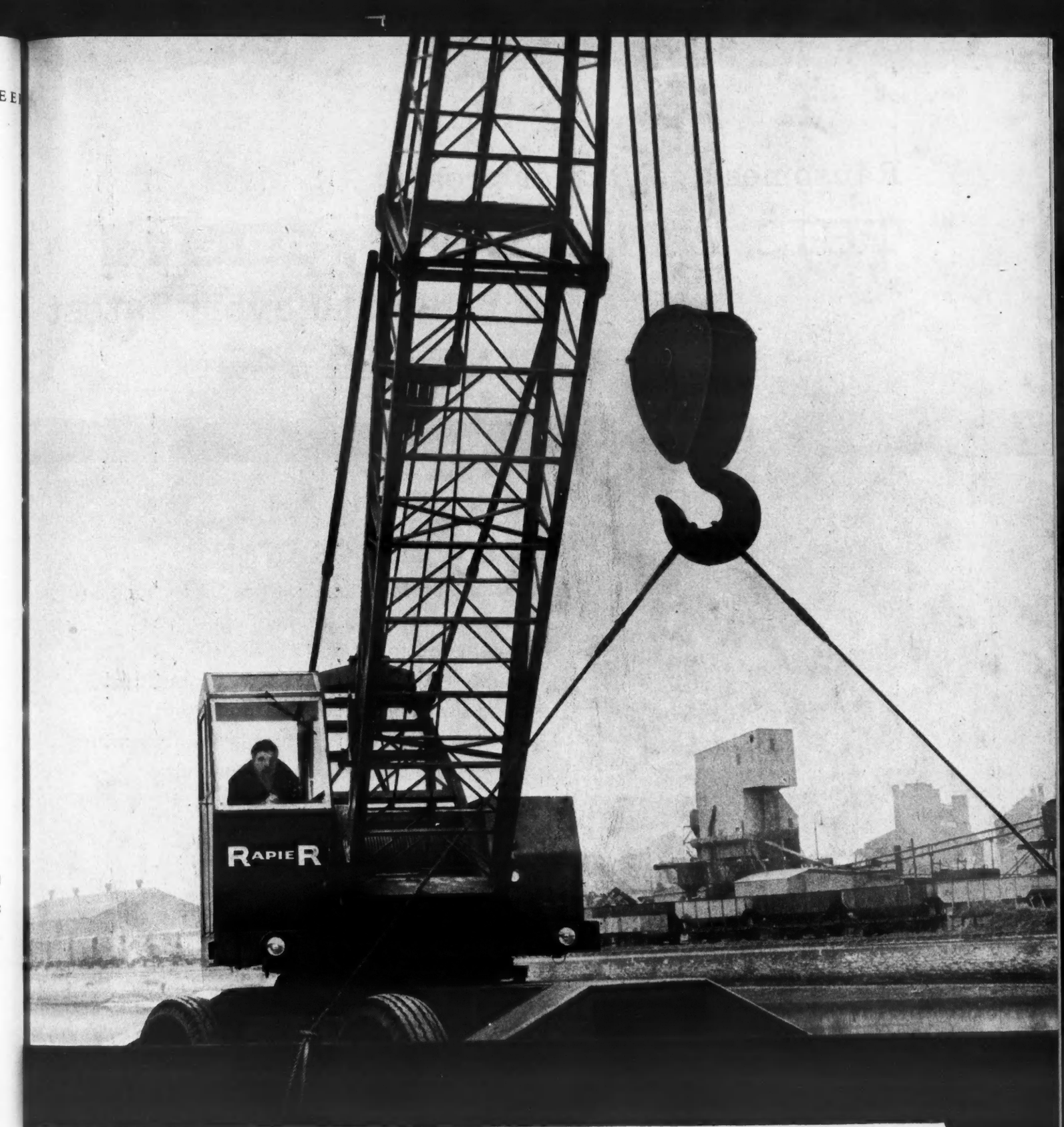

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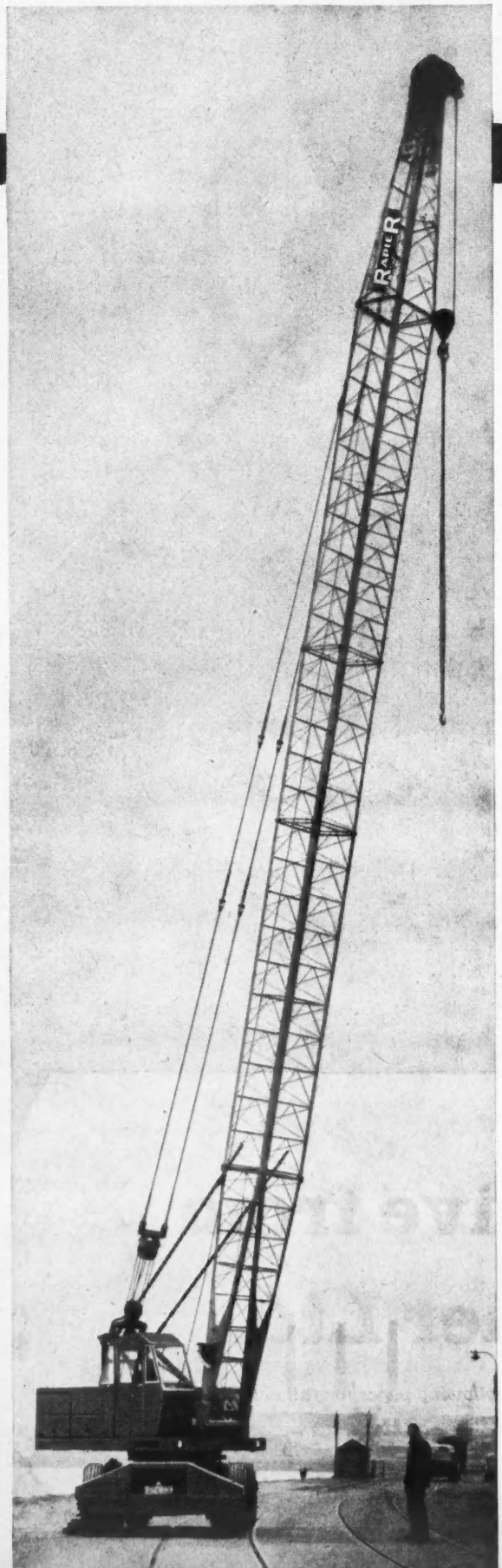

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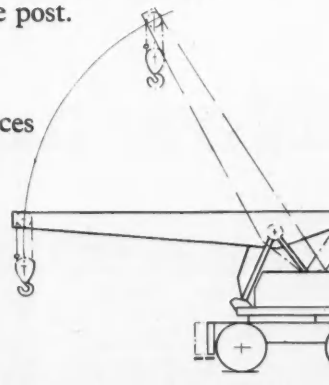

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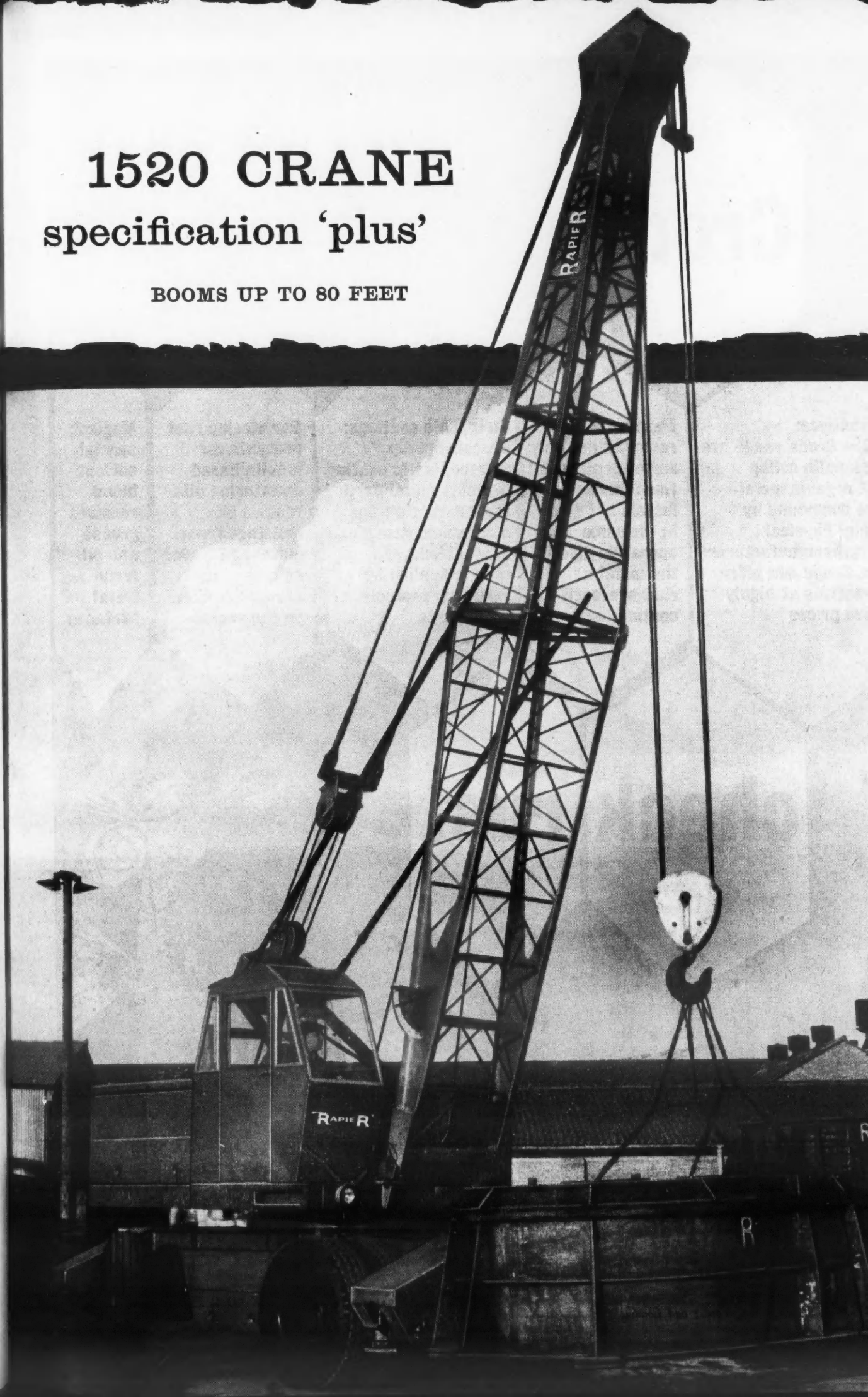

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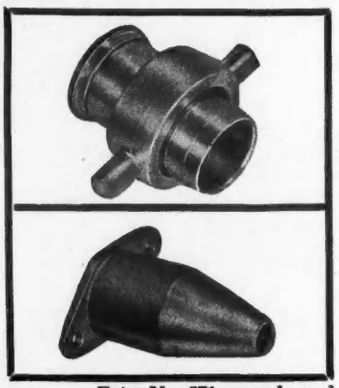

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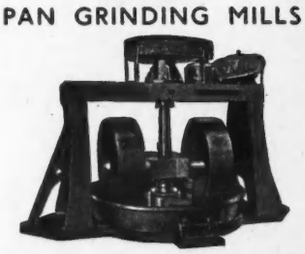

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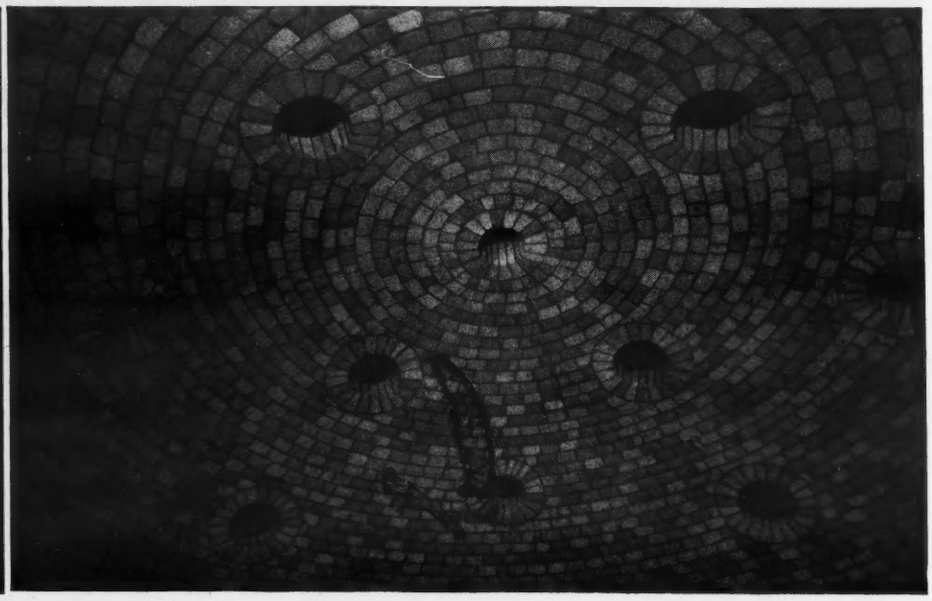

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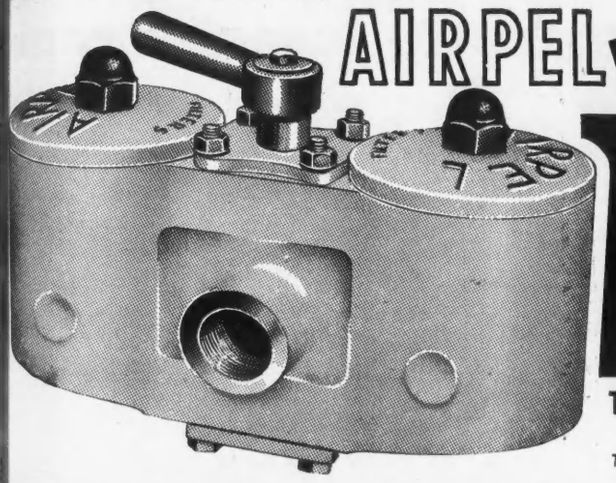

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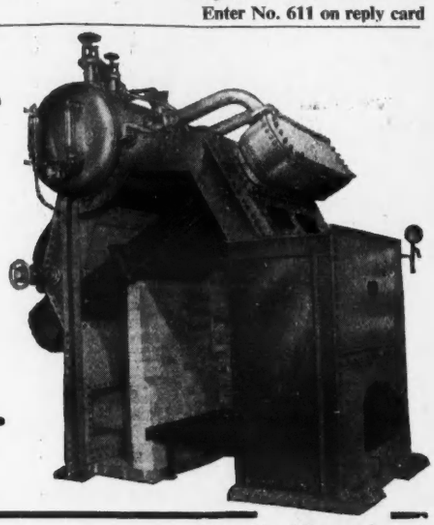

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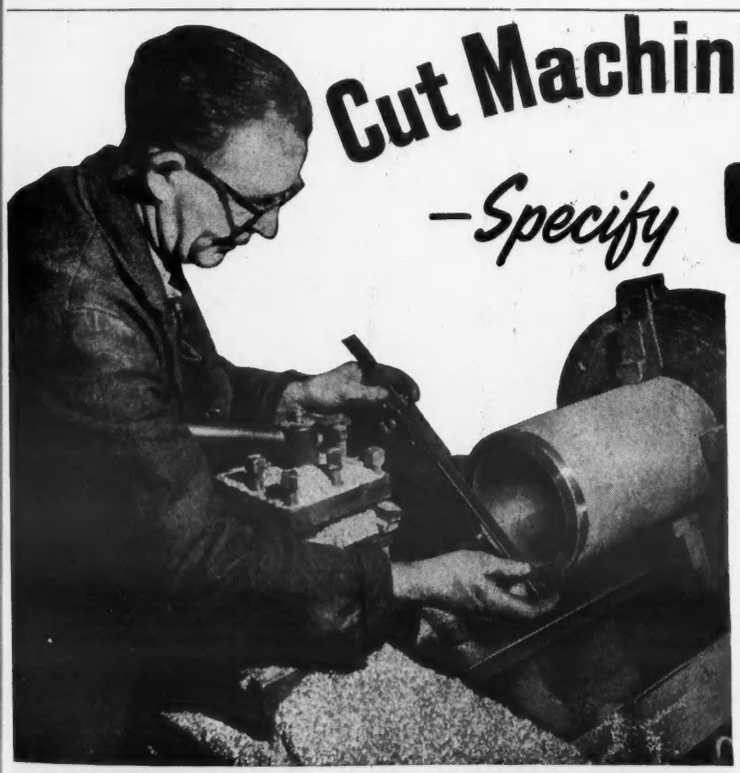

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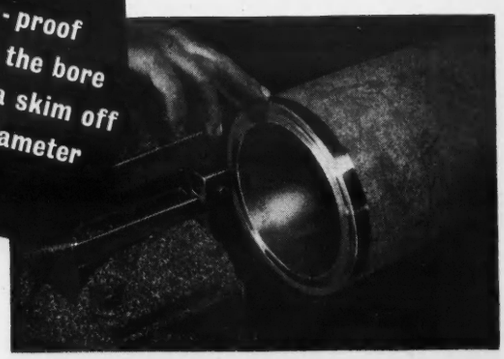

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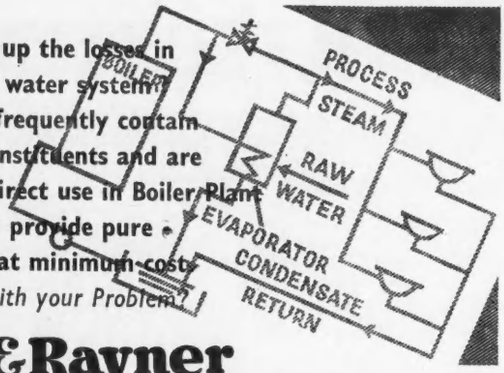

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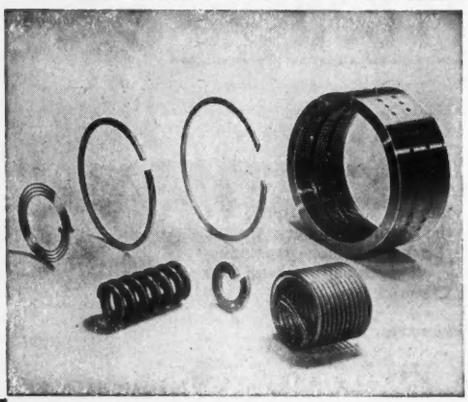

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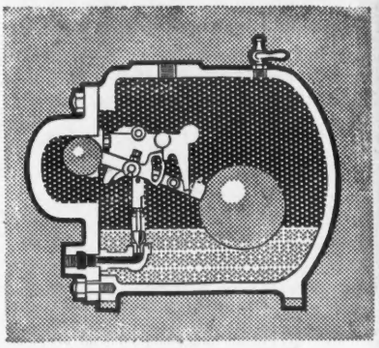

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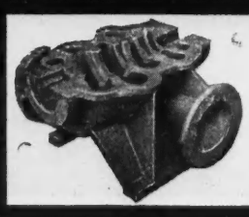

Large illustration shows a Shipham casting for a Centrifugal Pump Cover —overall length 4′ 0″; weight 1330 lbs. Alongside—Centrifugal Pump Body — overall length 4′0″; weight 2425 lbs.

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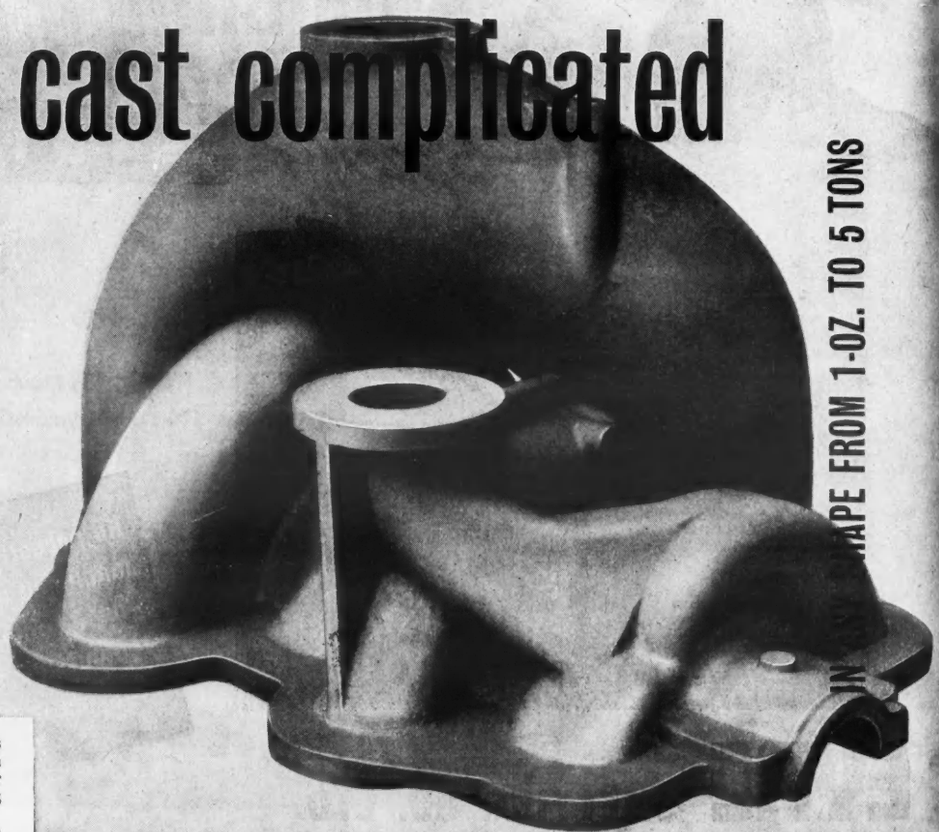

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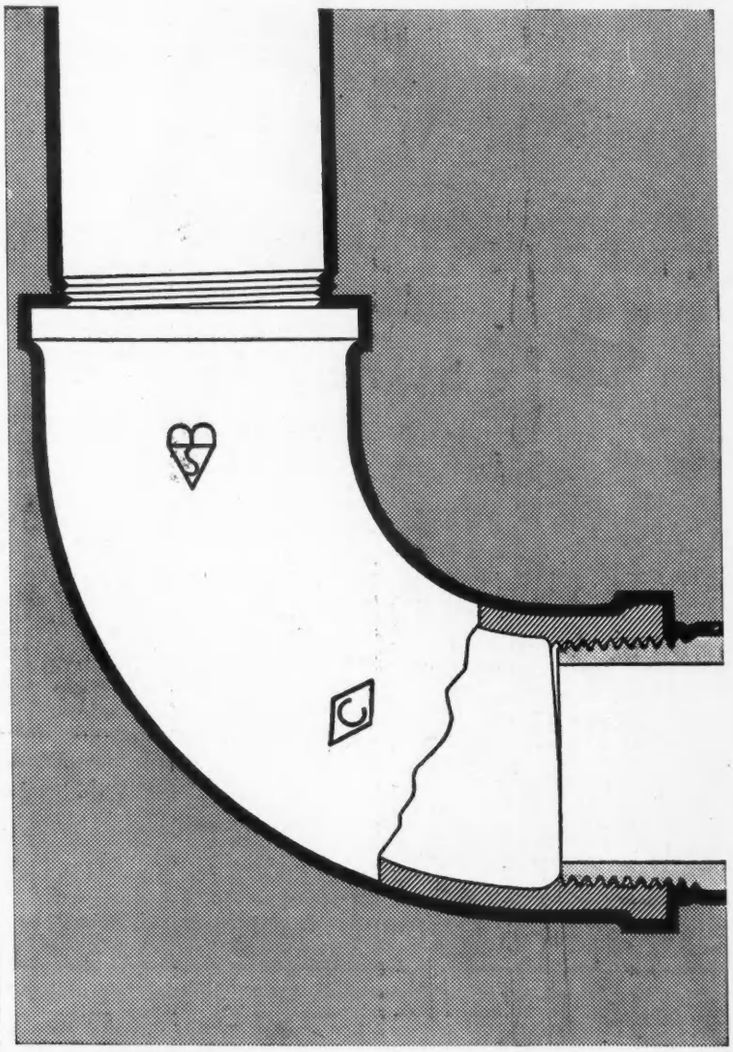

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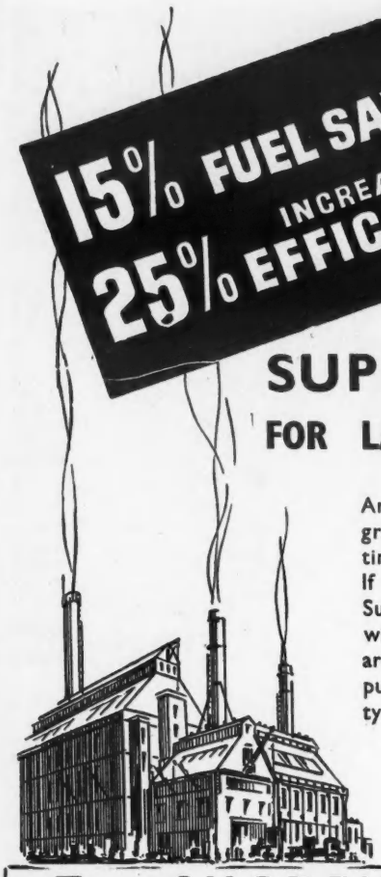

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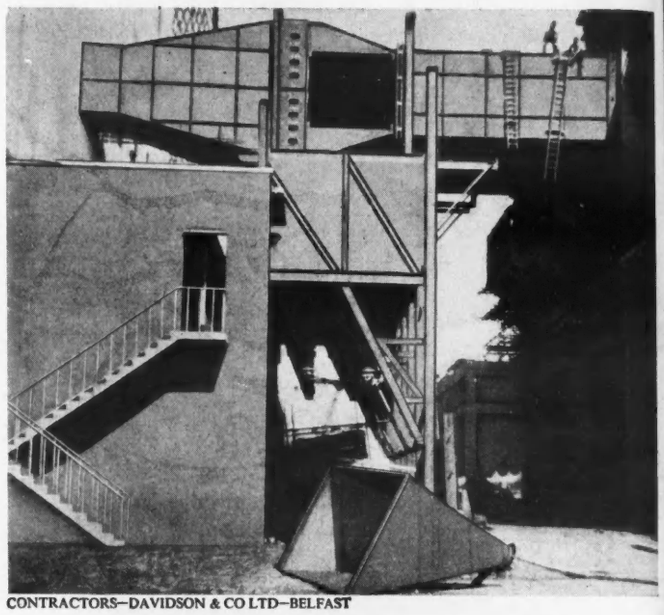

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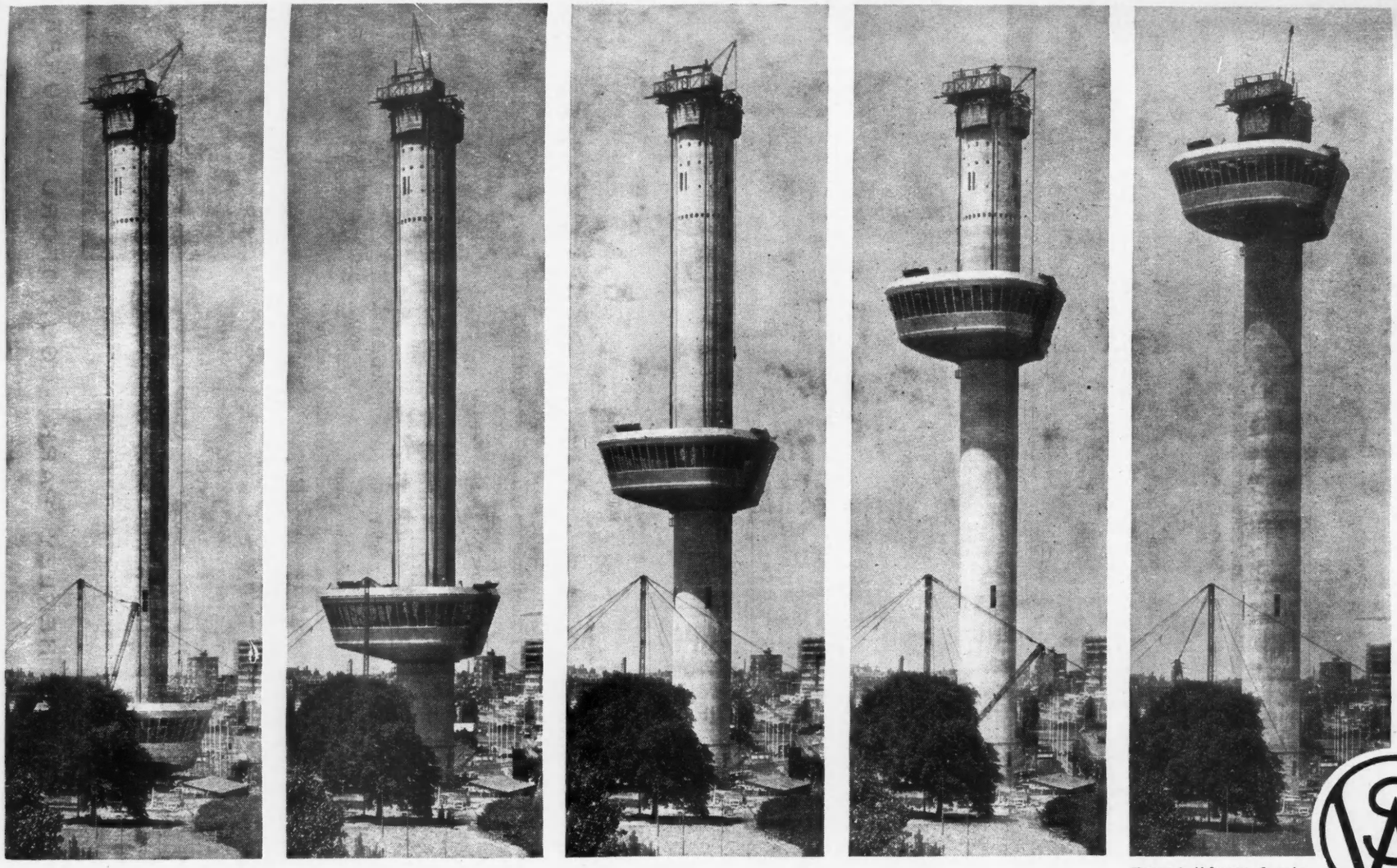

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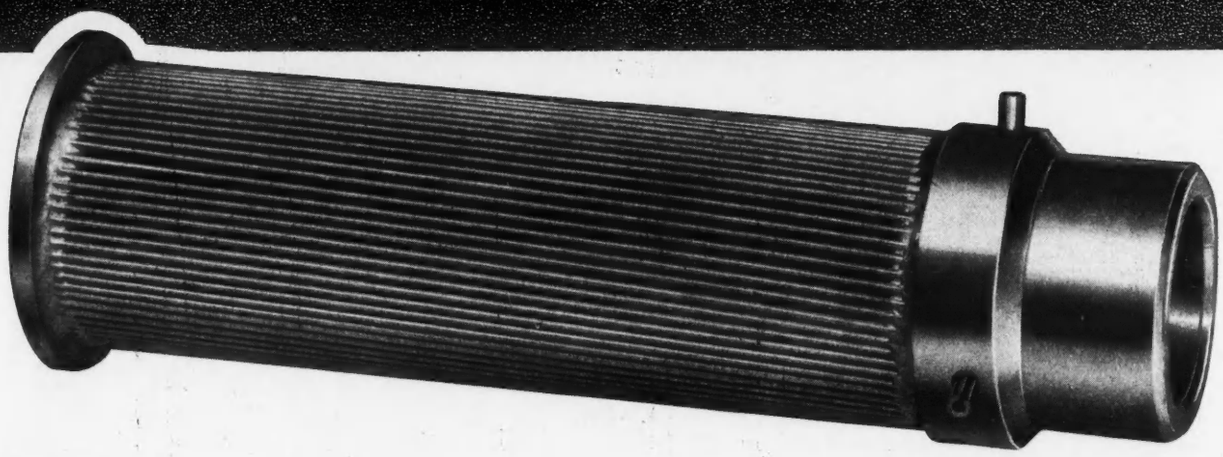


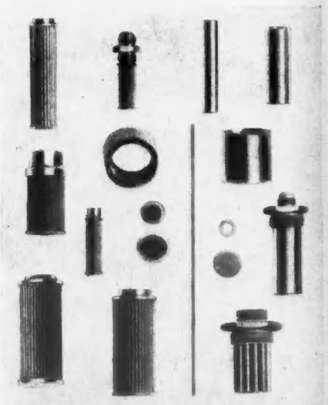
POROLOY CM.

Vokes now introduce a new all-metal filter medium of outstanding efficiency for the *controlled* filtration of hydraulic and lubricating oils, fuels, air, gases, acids, caustics and related caustic materials, chemicals and solvents at extreme temperatures and pressures. Poroloy CM filter elements can be made in any size or shape from a variety of metals—Stainless Steel, Inconel, Nickel, Copper, Steel and Nichrome being the most popular—features which, combined with special production techniques to give controlled pore configuration, enable filters to be individually designed for special applications. Metals can be selected with the particular requirements of the application in mind and the size of the pores can be controlled to deal with particles of between 2 and 250 microns. Poroloy CM filters are therefore 100% effective against a stated particle size, *the danger of media migration being eliminated by an accurately controlled sintering process.* The ultimate tensile strength of the elements varies from 2,000 to 60,000 p.s.i. and the operating temperature range is from −400°F to 1200°F.

The unique combination of properties found in Poroloy CM has led to its recent use in critical temperature conditions in the United States missile and aircraft industries, including installation in the Boeing 707.

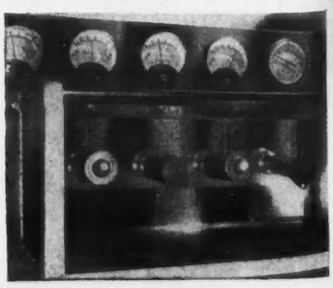
POROLOY T.

Similar in performance to Poroloy CM but manufactured by a different process, Poroloy T has an operating temperature range from −400°F to 1500°F. Pore size ratings are from 2 to 250 microns and tensile strength varies from 2,000 to 100,000 p.s.i.



The illustration (above right) shows the many sizes and forms—seamless tubes, flat discs, corrugated elements etc.—in which Poroloy can be manufactured.

Both filter elements are manufactured in conditions of micro-cleanliness and before despatch are individually checked for performance in the bubble point testing equipment (right).



Poroloy was developed by the California Institute of Technology and is manufactured in the U.K. under license from the Bendix Aviation Corporation, U.S.A.

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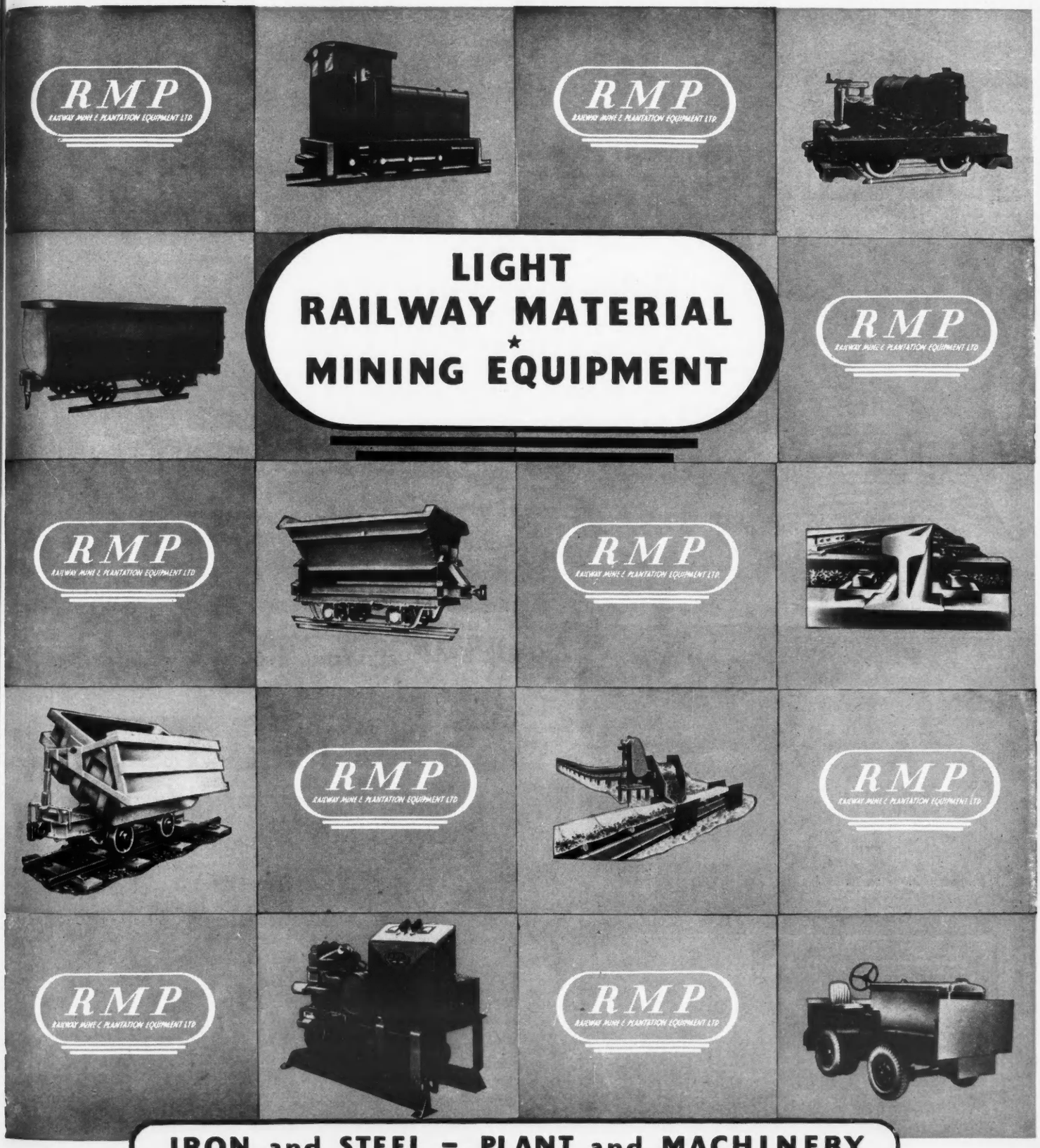

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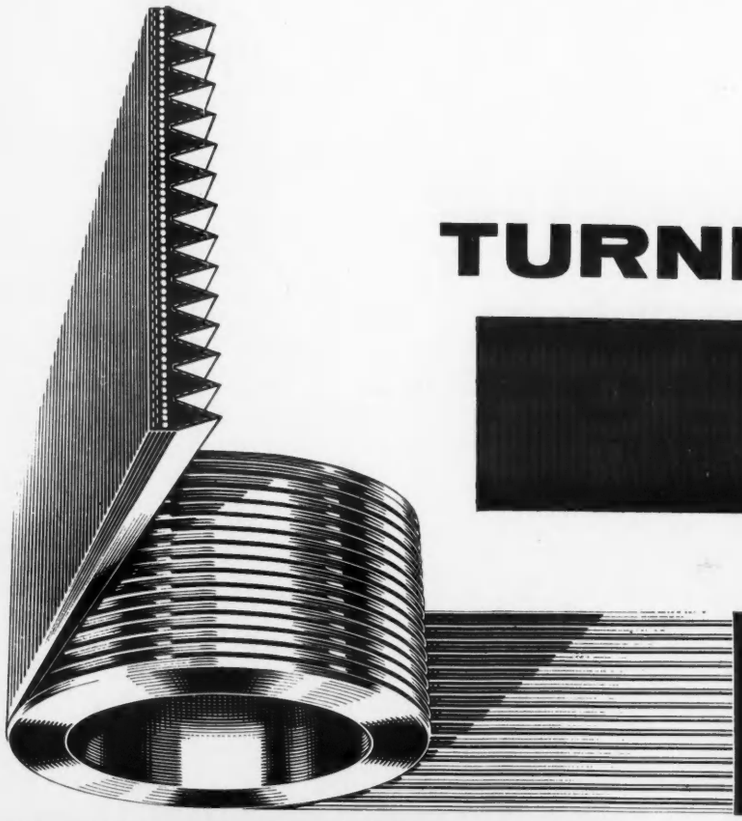
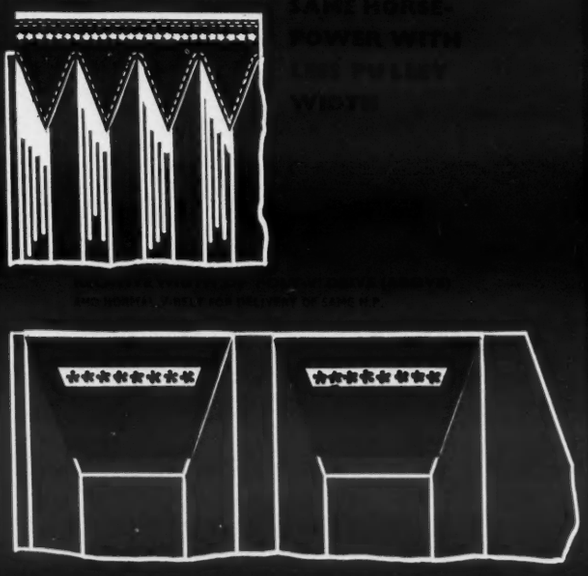


TURNERS

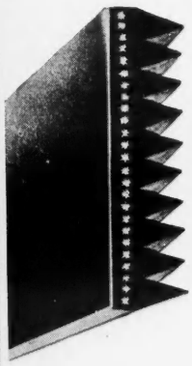
Comparative illustrations are ACTUAL SIZE

DRIVES

A NEW concept of power transmission



'POLY-V' BELTS ELIMINATE 'MATCHING' PROBLEMS



50

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48

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GREATER DEPENDABILITY
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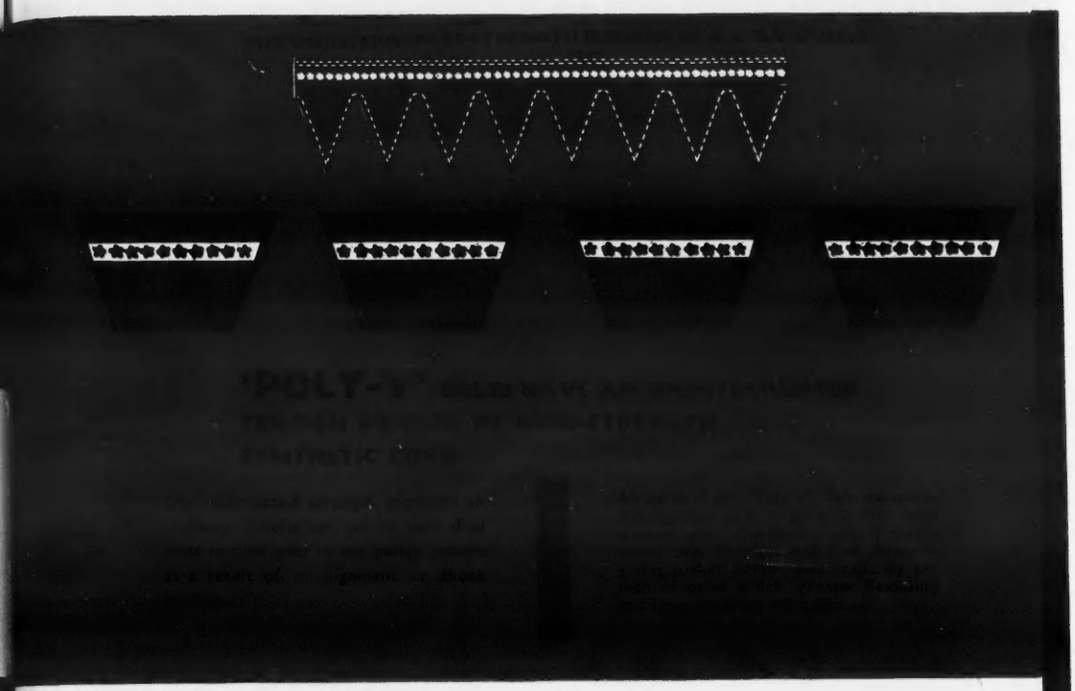
The "Poly-V" Belt is a SINGLE UNIT across the full width of the pulley, not an assembly of several V-Belts which may vary in exact length and ride differently in the pulley grooves.

'POLY-V' DRIVE advantages . . .

1. "Poly-V" Belts transmit the same horse power as conventional V-belts on very much narrower pulleys. 2. The unique design of the "Poly-V" Drive reduces pulley widths to the minimum, resulting in maximum saving in space, pulley weight and costs. 3. In a "Poly-V" Drive installation smaller pulley diameters can be used for the same speed ratios. 4. Being single units, "Poly-V" Belts overcome matching problems associated with other multiple belt drives. 5. Constant pitch diameters at all loads are maintained on "Poly-V" Drives. 6. "Poly-V" Drives ensure minimum vibration and cooler running.



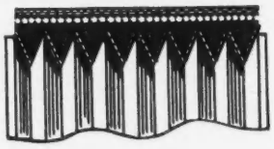
NO OTHER BELT delivers more power in the same space.

HERE is a revolutionary drive which consists of a single endless belt with longitudinal V-ribs and which drives pulleys grooved especially to mate precisely with them. The uniform pull of this single unit belt distributes drive load evenly over the full width of the pulley . . . resulting in a higher horse power capacity per inch of drive width than ever before possible.

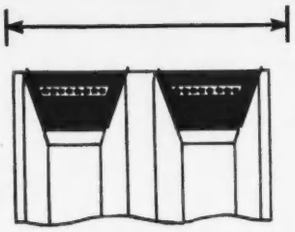
COMBINING the simplicity flexibility and unitary strength of flat belts with the "V-Belt" advantages of high speed ratios, short centre distances and freedom from slip.

FOR FURTHER INFORMATION on "POLY-V" cross sections 'M' ($\frac{3}{8}$" wide) 'L' ($\frac{3}{16}$" wide) and 'J' ($\frac{3}{32}$" wide), sections write for publications BPV 1 and 7.

'POLY-V' BELTS TRANSMIT MORE POWER BECAUSE THEY HAVE DOUBLE THE DRIVING CONTACT AREA

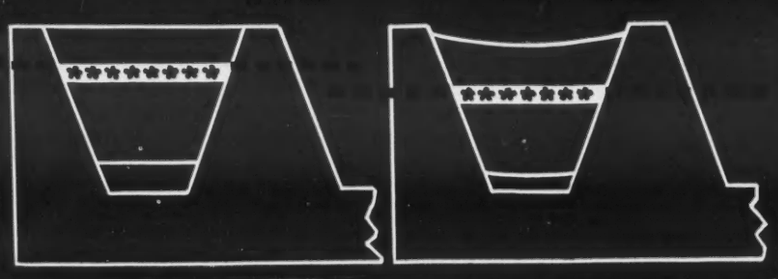


MEASURE THE TWO LINES AND YOU WILL SEE THE GREATER CONTACT AREA OF A "POLY-V" BELT IN THE PULLEY GROOVES



Full contact area over the entire pulley driving surface gives uniform grip. Cooler running arises from the larger belt and pulley driving surfaces.

Reduced pressure per square inch between belts and pulleys leads to less driving face wear, and long service life. Uniform Grip. Cooler Running. Less Wear.



7. "Poly-V" Drives provide greater interchangeability of belts and pulleys because there are only two belt cross sections instead of five for multiple V-belt drives. 8. Longer lives of belts and pulleys are obtained on "Poly-V" Drives. 9. "Poly-V" Belts are heat and oil resistant. 10. "Poly-V" Belts, due to their small rib section, can be used in place of flat belts by cutting grooves in existing pulleys. "Poly-V" conversions on stepped pulleys are particularly successful. 11. Reverse idlers can be used without serious reduction in belt life. 12. On quarter turn drives, losses of power are negligible because of elimination of drag and chafing.

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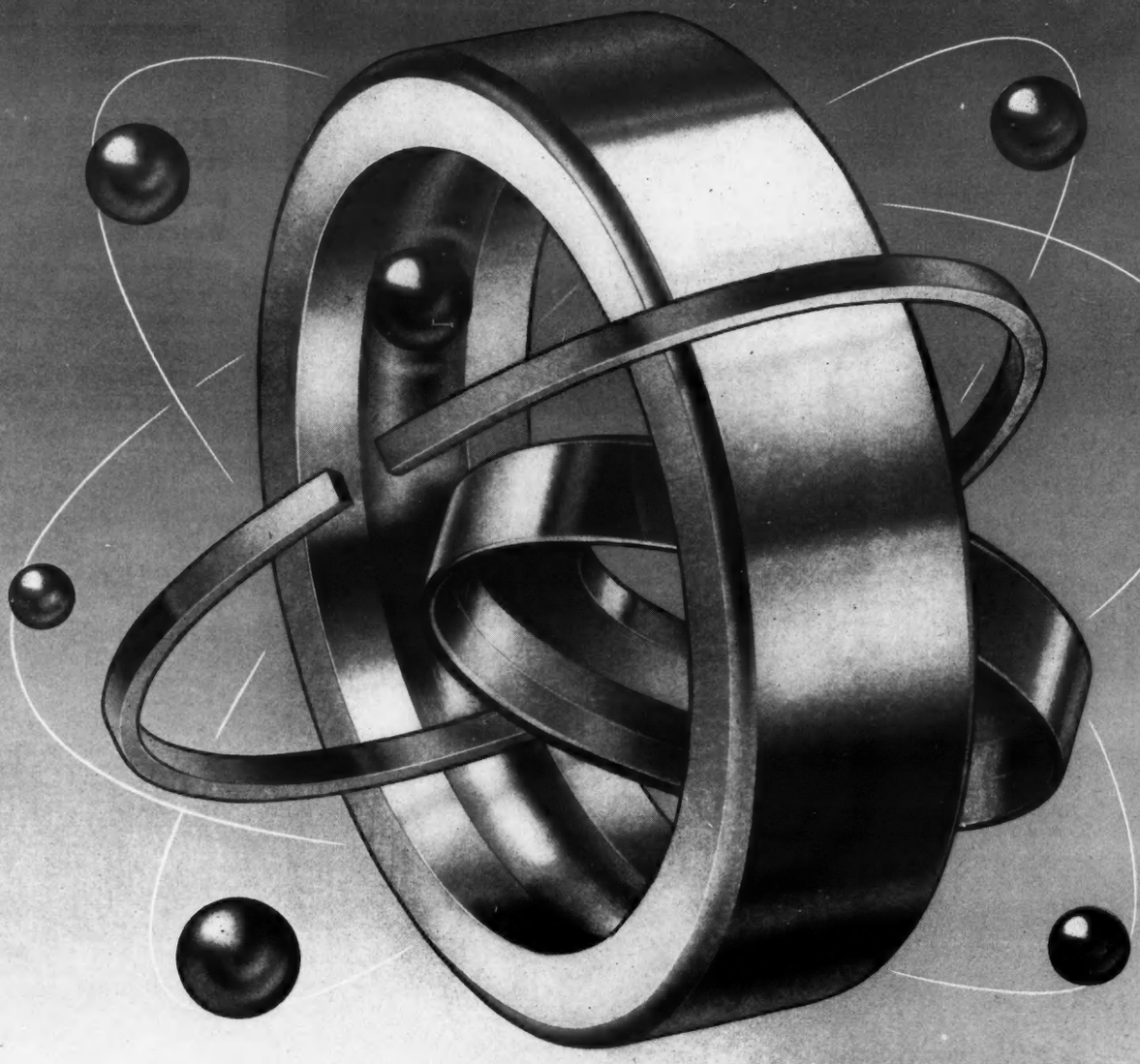

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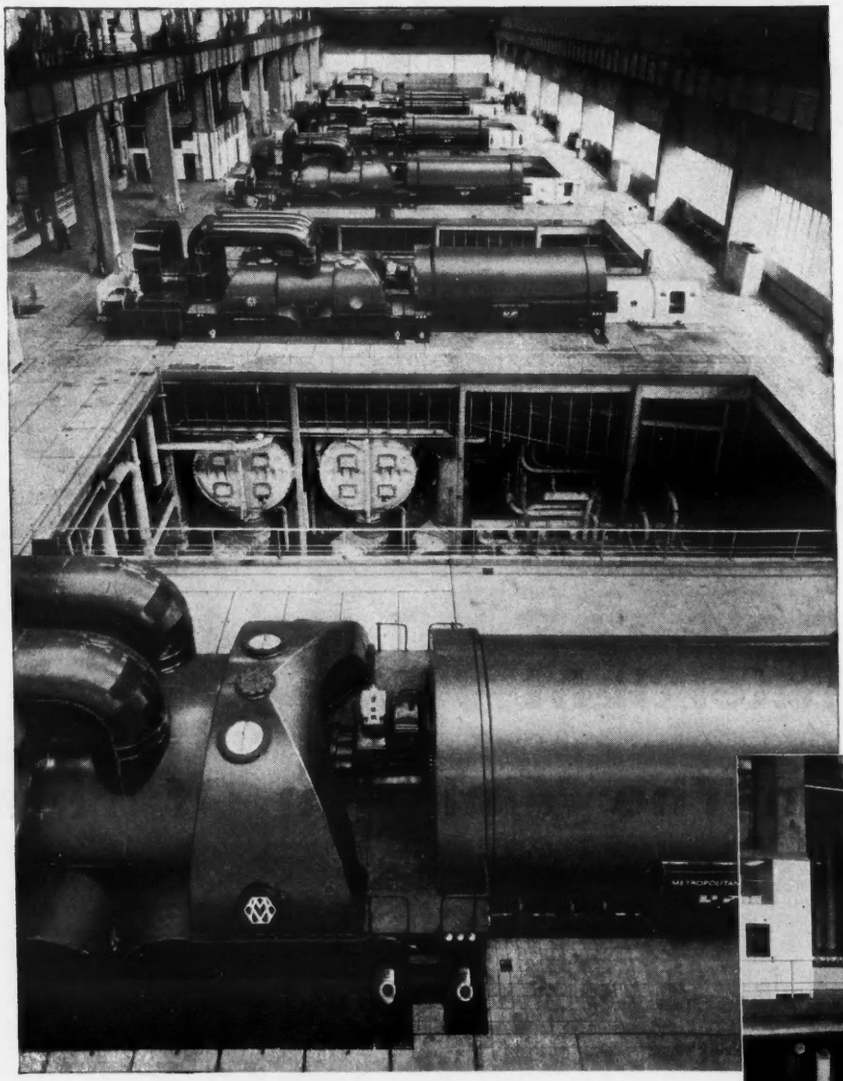

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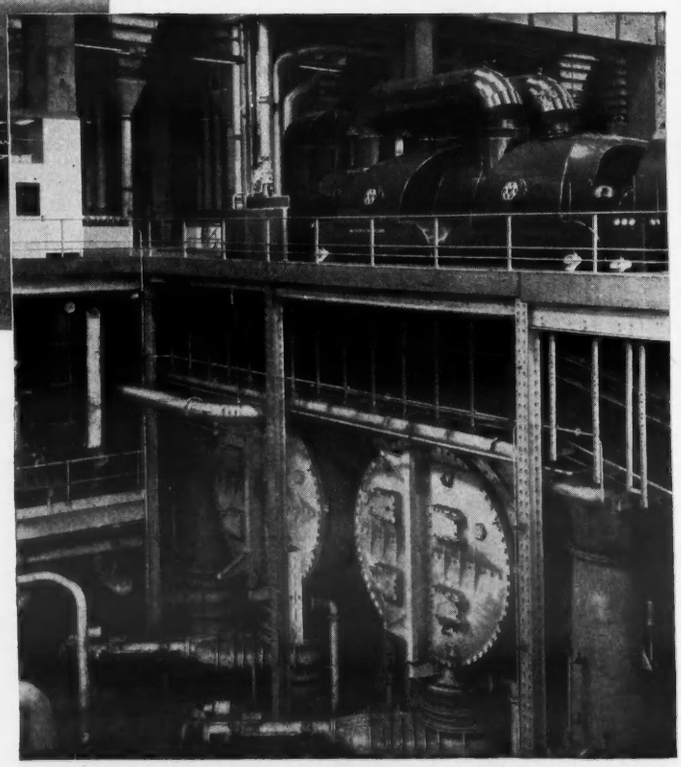

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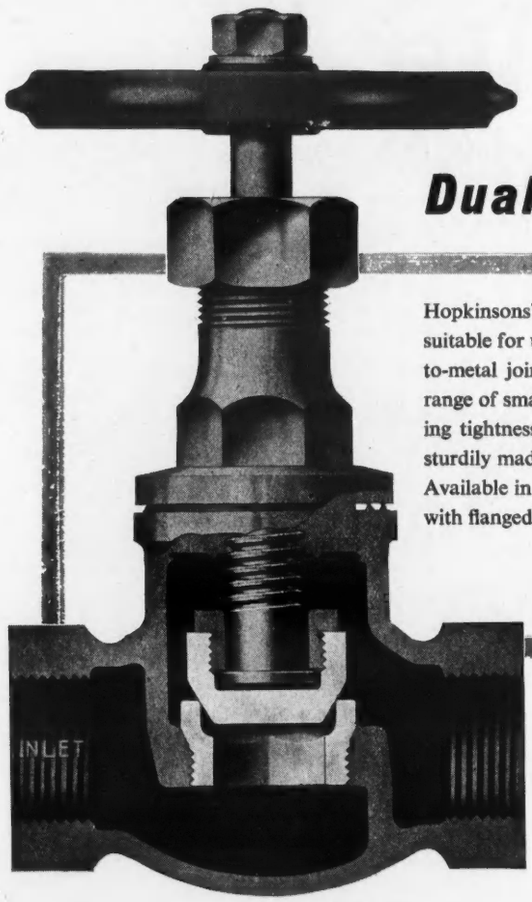

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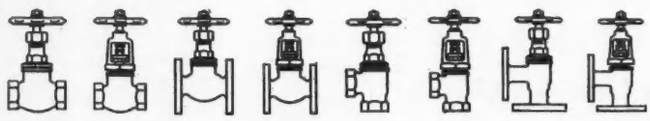

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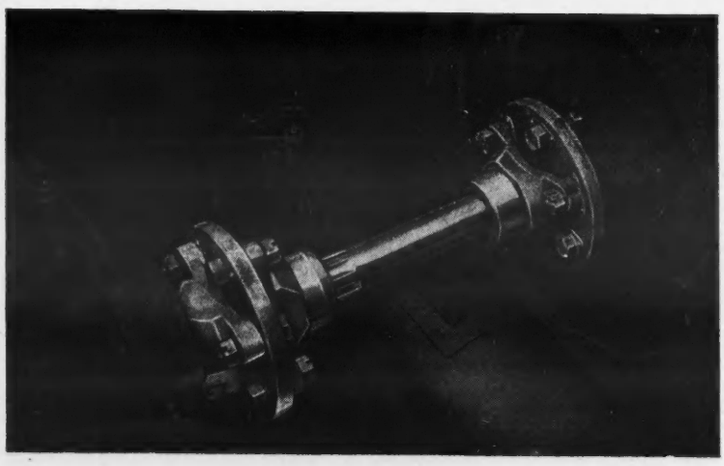

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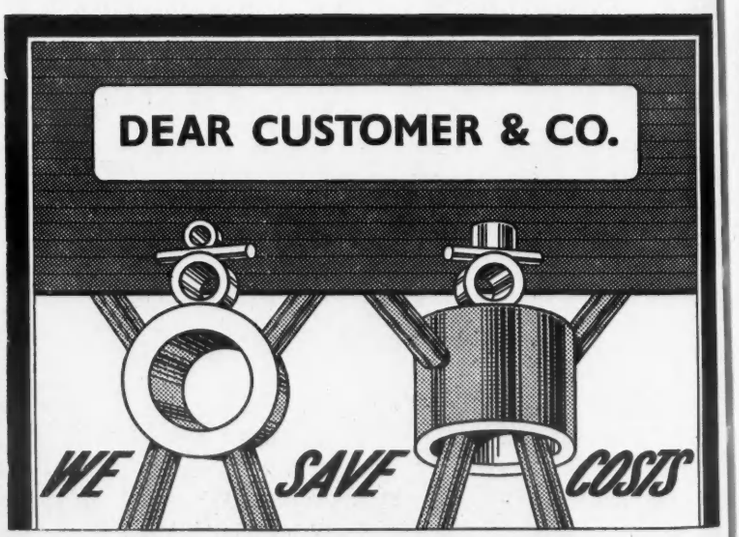

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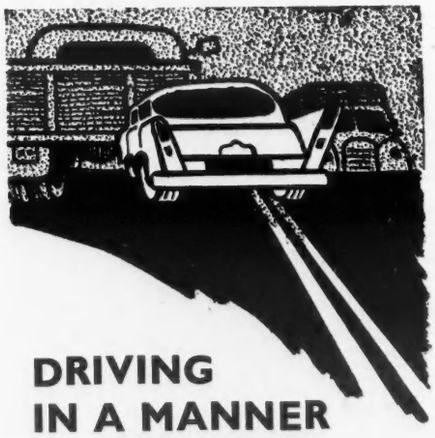

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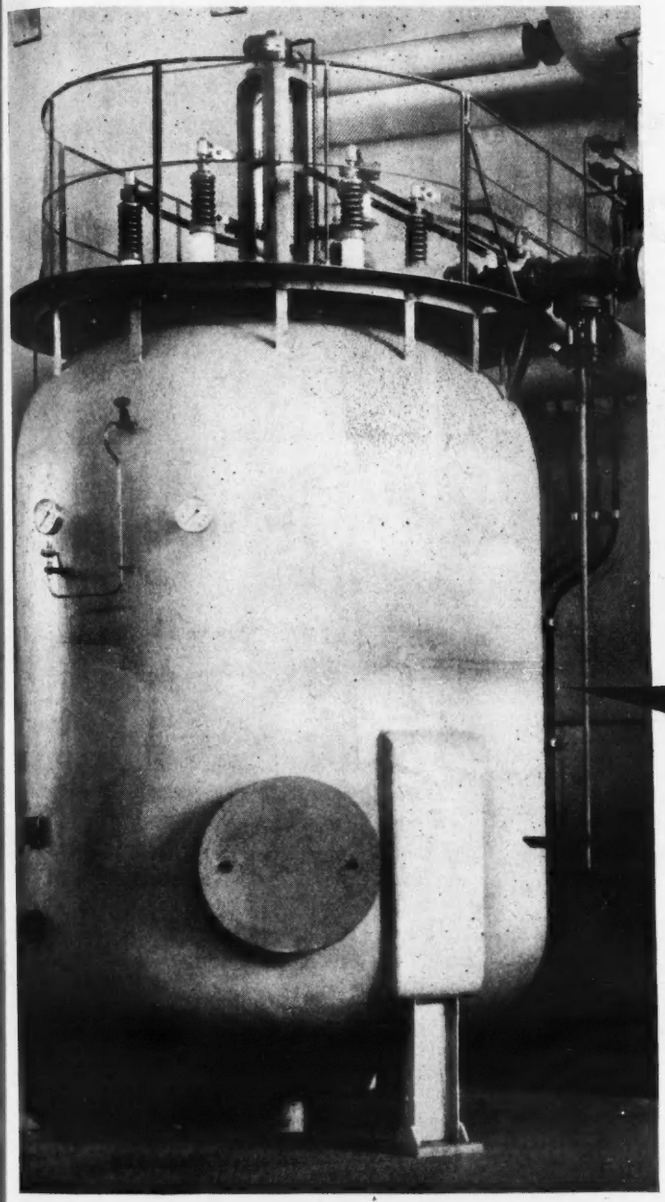

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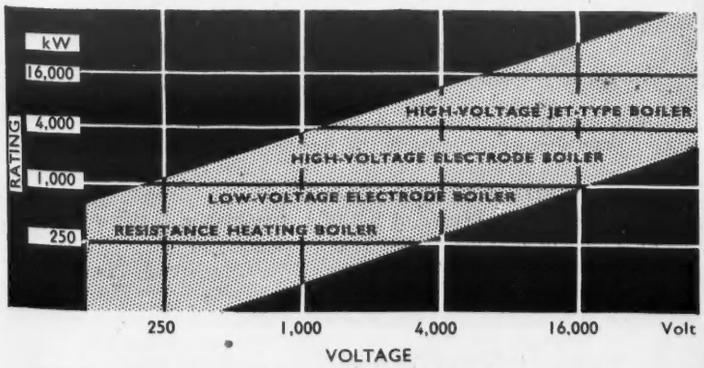

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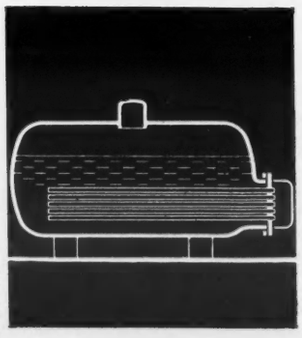
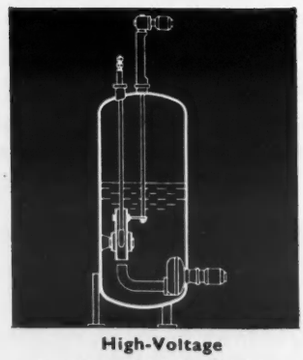
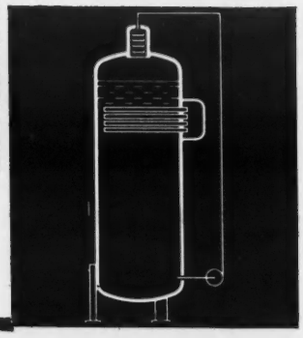


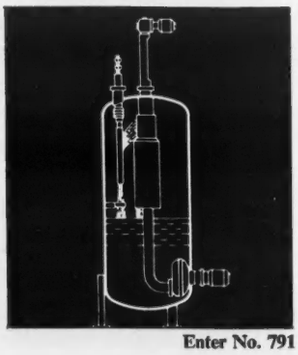
High-Voltage Electrode Boilers



Electric Boilers with Storage



High-Voltage Jet-Type Electric Boilers



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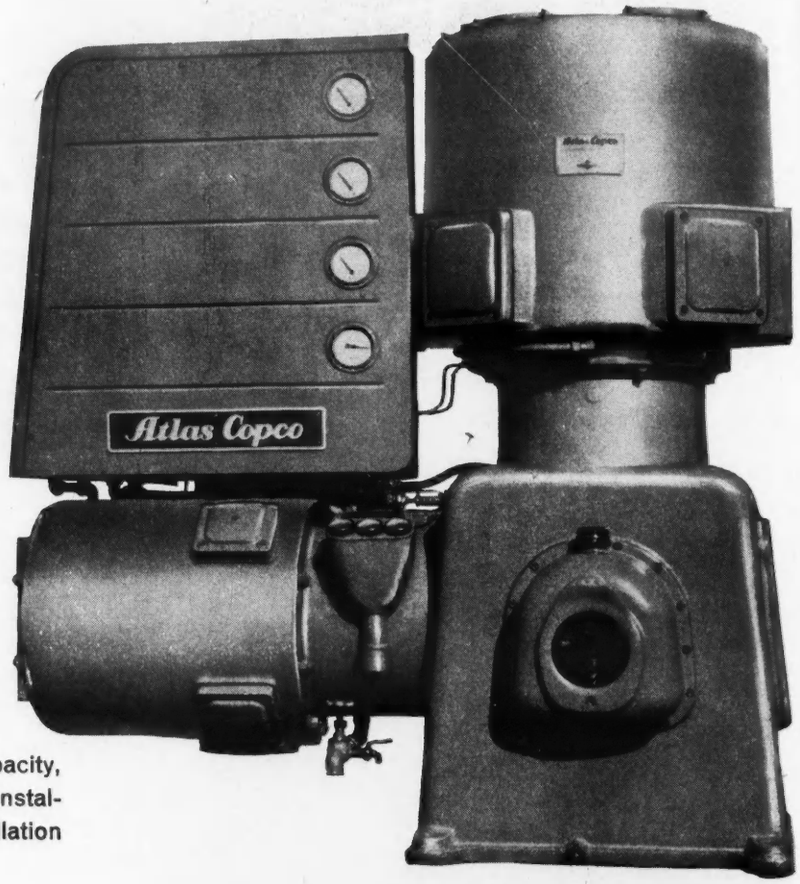

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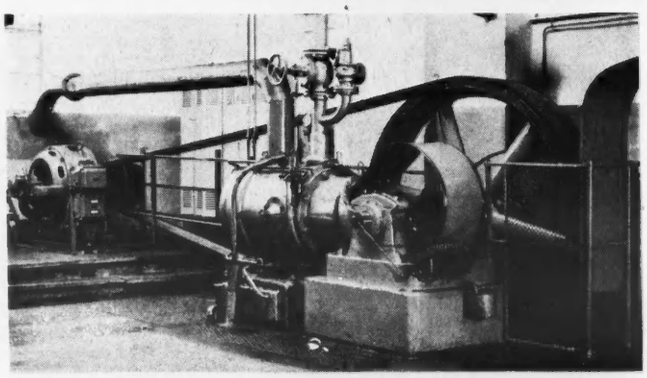

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THE ENGINEER

No. 5441 MAY 6, 1960 Vol. 209

HUMANISM AND TECHNOLOGY

It really is not much use trying to pretend that very many people in this country take much interest in the work of the United Nations Educational, Scientific and Cultural Organisation. Last Tuesday, for instance, there was a conference of that body at Church House, Westminster, to discuss the subject " Humanism and Technology." It was held in connection with a four-day visit of the U.N.E.S.C.O. Board to this country and during the morning the Duke of Edinburgh presided. Yet it was sparsely attended. Nor, perhaps, was the subject really very well chosen as one for an international conference. It was one, we suggest, far too encouraging to the utterance of platitudes ; too broad and all-embracing to lead to fruitful discussions ; and one better finding expression, surely, in lectures and books and in smaller, more intimate, discussions of facets of the whole subject. In Section X of the British Association for the Advancement of Science, for example, facets of the subject are handled rather well, just because audiences are small and lively. But for a real discussion of the subject, give us the fireside ; there the hair can really be taken down and, amicably, the fur be made to fly !

But, of course, something came out of the conference. There was made clear the still abiding fact that many humanists, who have throughout history existed in large numbers, fail to understand those upstarts, the scientists, who have only recently made very much impact upon human life. In consequence, society has rather tried to persecute them. As the Duke of Edinburgh remarked, " Society always persecutes people it does not understand." The non-scientific have, also, a real fear of science. They see scientists and technologists as the creators of destructive things like hydrogen bombs and frightening things like computers which appear alarmingly capable of more exact thought than man himself. They fear also the consequences of technological specialisation, holding, as Monsieur Berthein did at the conference, too much specialisation to be the very antithesis of culture, an argument, incidentally, which technologists may feel inclined to throw back at some practitioners on the arts side. They cry out that too obtrusive a scientific education tends to suggest to young minds, as Sir James Robertson noted, that only by the scientific method can the truth be derived at all. Nor, we feel we must interject, can we disagree with him ; for it takes many years of contact with less scientific people to make some science students realise how complex most human problems are and how useless the scientific method of simplication is for their solution. At the end of the morning session, Dr. Veronese expressed these fears succinctly : " Can technology be contained within bounds ? Can it be superimposed on traditional societies without endangering their integrity, their values, their *raison-d'etre* ? Or must we accept as inevitable the disappearance of social structures, beliefs, customs, forms of art, understanding of nature, kinship within the family and the village, the richness and depth of the life of the spirit and of religious faith ? Must all these sink into the anonymity of great cities without souls, be swept away by the strong winds of intellectual exchange, wilt before the final onslaught of rational understanding ? "

Engineers, we suggest, being part scientists, part artists, may be able to see both sides of this question better than most. Though appalled, like other citizens, by the destructive possibilities of modern science and technology, they are much more entranced by its constructive promises. Yet, if the results of technological advance are really to benefit mankind culturally as well as materially, many would be quick to agree that technologists should acquire more understanding of humanists. Do humanists, we wonder, similarly appreciate their need to try better to understand technologists ? For we do not think the fears of humanists are fully justified. As Dr. Veronese expressed it, in the past " every cultural peak of every civilisation was accompanied by a high degree of technical accomplishment." And, again, " technology itself will help man to gain a higher, purer sense of the nature and power of the spirit, henceforth unencumbered by superstitution, by ancestral fears, by ancient notions of potent magic, of ghosts and dark forces." It is, of course, right that fears and the resulting criticisms should be expressed even if they are sometimes misdirected. For anyone who appreciates what dreadful things spreading industrialisation did in the past and still sometimes does to-day, cannot doubt that criticism is still needed. But we are fully confident that the rapid rise of technology, challenging ancient cultures, is something that man will find the means to meet. For, unexpectedly—almost incomprehensibly—it is the humanists who seem to have less faith in man than the technologists ! They fail to appreciate, we suspect, that an engineering works, for example, is in fact a very human place and that anything which tends to destroy its humanity inevitably leads to strikes and other troubles and, if persisted in, to the extinction of the firm by force of economics. Humanity, in fact, insists on being human ! Moreover, the advance of technology has given more power to people in the mass who did not possess much before ; and it tends, so it seems to us, for that reason, to make the world more, not less, fit for human beings to live in. To quote Veronese once more, " technology . . . will at last . . . if my hopes are realised, liberate man, all men, so that they may live more fully in the spirit." We suggest, indeed, with much of history in our minds, that it has been " humanists," arrogantly convinced of the rightness of ideologies and attempting to force them upon all who think differently, rather than peaceable technologists, striving to improve their knowledge of nature and to use it for human convenience, who have consistently been the real danger to the world. But perhaps we should have kept that inflammatory remark for the fireside !

NOT MUCH JOY FOR DECIMAL DISCIPLES

Elsewhere in this issue we print a little about the work and conclusions of two committees set up respectively and independently by the British Association for the Advancement of Science and the Association of British Chambers of Commerce, but acting jointly, to consider, once more, whether Britain should adopt a decimal coinage and the metric system of units. For engineers the chief interest lies in the latter inquiry, so we pause only long enough to record the opinions of the committees that " there is a strong case for the adoption of a decimal system of coinage " and that " the time has come for a decision to be made in principle " by the Government upon the matter.

But, whereas it would clearly be advantageous to bankers and business men (though possibly less advantageous to domestic buyers and retail traders) to change to a decimal coinage and neither outrageously expensive nor very difficult to do so, the situation is found to be very different when the possibility of adopting metric units of measurement is studied. The basic point here seems to be that it would be very costly for industry to make the change, whereas the advantages of so doing are not found to be very high under present conditions. The committees report, for example, that so far as the engineering industry is concerned, " the greater convenience of calculation expected from the metric system is a minor factor as compared with the task of establishing and adopting a very wide range of international standards." Also " the difficulty of establishing a standard and bringing it into general use is considerable and the expense and difficulty of changing a standard already in use may be very great. In the eyes of the user, therefore, the fact that any particular standard is already in established use is one of the strongest, if not the strongest, of reasons for preferring it to any other." In consequence, there is " little disposition upon the part of the engineering industry in the U.K. and perhaps still less in the U.S., to allow a preference for the metric system, as a system of measurement, to outweigh the very substantial advantage of retaining inch/pound standards and of seeking their adoption as international standards." Back in 1951 the Hodgson report by a committee of the Board of Trade stressed that agreement with the Commonwealth and the U.S.A. should be a necessary prerequisite to the adoption of the metric system by the U.K. The committees confirm that finding and add that in the Commonwealth, apart from India, there is little active support for the metric system and even less for it in the U.S.A.

It is sometimes asserted that the use of inch/pound units hampers the export trade of this country to countries using the metric system. But the committees found little to support that assertion. " Other factors such as duties, quotas, standards of performance, quality, finish, price and availability of currency, have far greater weight." Some Trade Commissioners, however, thought that business was being lost through exporters not printing catalogues, performance data, and other information about their products in the language and units which importing firms could understand. The committees draw the inference that " all other things being equal, the question of units plays little part in international trade." Broadly, we suppose the conclusion can be drawn that though a large number of people are in favour of adopting the metric system in principle (the committees note that 84 per cent of the respondents to the questionnaire did so), few advocate a compulsory change without the Commonwealth and the U.S.A. acting likewise. For the disadvantages of not changing are not sufficiently high. There remains, of course, as the committees note, a world trend towards the adoption of the metric system. It leads them to suggest that the situation ought to be reviewed at regular intervals—they suggest every two years, which seems rather a short time to us.

But even if there seems rather little chance that the metric system will be compulsorily adopted in this country for many years ahead, the disciples of decimals can still claim a little joy. The use of decimals of the inch is already ordinary practice in engineering production ; and there is, we think, a quite widespread desire to see U.K. units rationalised and the disappearance of the more odd ones. The committees actually recommend the disappearance of the " rod, pole or perch " and the corresponding square measures ; and also of the chaldron, quarter, bushel and peck. They suggest, also, the adoption of the cental of 100 lb, the elimination of the hundredweight and the use of the short ton of 2000 lb. But they take care to point out that " there is no likelihood of reaching a comprehensive or coherent system in this way." The trouble is that different industries or trades tend to decimalise different units so that simultaneously there can exist decimal systems based on the yard, the foot and the inch, the ton and the pound, and so on.

COAL—THE MORE DISTANT PROSPECT

We always enjoy listening to Mr. Schumacher, economic adviser to the National Coal Board, or reading what he has to say. For, almost, he convinces us that coal has a brilliant future before it. He spoke at a conference organised at the end of March in London by the National Union of Mineworkers, of which we have only recently received particulars. His argument, of course, is founded on the rate at which the demand for oil is increasing, the fact that it is, like other fossil fuels, unrenewable, and upon the presumption that, even if nuclear power becomes competitive with power generated from fossil fuels, it will not be able to serve all the multifarious purposes for which coal and oil are used. The demand for oil is tending to double itself every twenty years or so, that is it is increasing logarithmically ; and anyone who knows anything about such a curve must appreciate that, however large the undiscovered reserves in the world may be, they cannot possibly stand up against such exploitation for longer than a period to be reckoned in decades rather than centuries. Nor is there any reason to expect any slackening of the rate of increase of the demand. For, at present, less than one-third of mankind consumes more than seven-eighths of the world's fuel supplies ; and the other two-thirds are raising their standards of living and demanding more fuel. Moreover, the population of the world is growing rather rapidly. In effect, Mr. Schumacher argues that perhaps within twenty years, perhaps later, but certainly in the not very distant future, mankind will have to think about preserving oil only for doing those things that cannot be done by other fuels ; and that, of course, is where coal comes in ! We have no doubt that Mr. Schumacher is right ; and not much doubt about his timing. For even an error of a whole order of magnitude in estimating oil supplies does not seriously affect his argument—if there were as much as ten times as much oil in the world as he supposes, the approach of exhaustion consequent upon an exponential rate of increase of demand would be put back only some forty/fifty years. But what we must doubt is

whether it really will be coal which replaces oil ; because, thinking back upon the discoveries of the last fifty years or so, we start back affrighted at any attempt to prognosticate upon such a matter.

We heartily disagree, like Mr. Schumacher, with the contention that just because the coal mines have fallen upon harder times, attention should be concentrated at present on the exploitation of more economic seams at the expense of the less economic and that pits operating at a loss should be abandoned. For Mr. Schumacher made two things clear which may not be clear to everyone. The working, first, in a mine of the cheaper seams may and usually does make it subsequently impossible to work the less cheap ones ; and once a pit is wholly abandoned it is seldom possible to reopen it. Both practices, therefore, are wasteful of coal resources which future generations may be glad to have. We have, claims Mr. Schumacher, a moral responsibility not to waste assets which the future could use. Incidentally—it is part of Mr. Schumacher's thesis—has not man a similar responsibility not to use oil wastefully for purposes for which coal would do as well as oil, even though oil may be the cheaper at present ? If Mr. Schumacher could convince the world upon that point, the future of the coal industry, both here and on the Continent, would look much brighter !

COMPUTER PROGRAMMES FOR ENGINEERING

When comparisons are made between the time occupied in preparing a computer programme and the time a computer takes to solve a problem, the inference is sometimes drawn that computing is justified only in a limited number of highly specialised cases. This results from a misunderstanding of what the programme does. The programme, in fact, is a set of instructions for solving not a particular problem, but a particular kind of problem. Once written, it can be used again and again. When it is in the computer store, data relating to individual cases can be fed in as often as required and the answers will be produced. For this reason, programmes are filed and classified at computer centres, and as their variety increases, so does the likelihood of one being found to fit a given problem. To emphasise this point a one-day seminar was held recently in London by I.B.M. United Kingdom, Ltd., at which a series of short talks was given on the range of engineering subjects already covered by the company's library of programmes for use on the " 650 " computer. One of the applications described was to cut-and-fill problems in highway engineering—a subject to which we have referred in the past—and it was stated that although the computer normally works from a punched card input, it can be adapted to accept cards marked with pencil in the field. Other titles in the library cover chemical, electrical, mechanical and petroleum engineering, while various routines for statistical analysis are of very general application. With regard to programming and computing times, the case was quoted of a programme written for a diesel engine manufacturer to obtain data indicating the lines on which the development of engines should proceed in order to obtain higher thermal efficiencies. The overall cost of programming and computing was some £500, of which about half was for writing and testing the programme. The total elapsed time from receiving the problem to delivering the first results was two and a half months, but now that the programme is available and tested, later results have been obtained within twenty-four hours.

Programmes are catalogued with their authors' names, for there may be many routes to the solution of a problem and different exponents of the art of programming approach solutions by methods as individual as those of a Poirot or a Maigret. It is recognised, however, that there are possible pitfalls in the transmission of ideas from the man with a problem to the programmer and so a simplified code has been devised in which the former can quickly learn to write his own programmes. This is translated automatically into the more complex form of computer instructions, and only a very slight limitation is imposed on the work which can be undertaken by using this facility. Some commercial problems are conveniently tackled by a computer and a demonstration was given of the calculation in two or three minutes of a four-week production schedule for television aerial components taking account of existing stocks, forecast demands and various seasonal factors. As computing resources and facilities are more widely understood, such services are likely to be in greater demand. The only users who may be disappointed with its results are those who regard the computer as a crystal ball instead of a machine which depends entirely on the careful selection, preparation, and presentation in programme form of the material on which it must work.

The Engineer—100 Years Ago (MAY 4, 1860)

" ENGINEERING EDUCATION "

" The entire claim of civil engineering to be recognised as a profession rather than as a craft is based, all will admit, upon the scope and importance of the knowledge with which only civil engineering can be properly practised. Civil engineers, at one time, were mostly uneducated men, respected, no doubt, for their skill, but hardly flattered for their genius, even when they might happen to possess any. When Brindley had carried a navigable watercourse high over a navigable river there was a good deal of vague wonder, and much of it was doubtless of the kind which an astonishing acrobatic feat would have evoked. Strong prejudices on the part of the public and a want of education excluded the engineer from the position to which he has since attained. When engineering services came to be in request, and when high social and pecuniary rewards were held out to men capable of winning them, engineering assumed its proper place. And whilst its successful practice depends upon the constant exercise of sound judgment, it depends hardly less upon the possession of varied and exact knowledge—such, indeed, as would become the highest professional position. Besides that kind of intuitive knowledge which, in any art and in any profession, is indispensable to ordinary skill, an engineer should possess extensive mathematical, philosophical, chemical, geological, architectural, and commercial knowledge. . . . .

" Whenever a strong spirit of conservatism is manifested in the infant profession of civil engineering—undeveloped and hardly half wrought as it still is—there is reason to fear that there is too much copying going on. No engineers were ever so radical as our great masters. They delighted in seeming impossibilities, and did not remain long content with their achievements. Were those men still living there is no knowing what extraordinary strides we might now be making. In an acquisition of the knowledge for which, unlettered as they often were, these men were distinguished, young engineers will find their surest means of advancement."

Industrial Value of D.S.I.R. Research—No. I

PART II—(*Continued from page* 715, *April* 29)

J. BLAKEBOROUGH AND SONS, LTD., BRIGHOUSE

Valves.—This firm is, of course, interested in the manufacture of water control valves. Its representatives were aware of the N.E.L. paper on this subject. But they did not think that any use had been made by the firm of that paper as, in their view, with the exception of the design of valve No. 3, the principles stated in the paper have been embodied in the design of valves for periods up to at least thirty-eight years.

The type 1 valve described in the paper did not seem to them unusual in design.

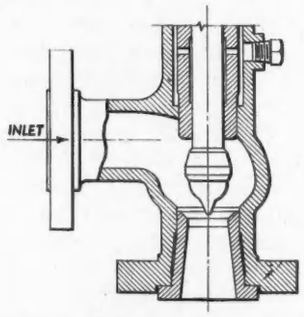


Fig. 15—Valve similar to type 1 made by J. Blakeborough and Sons, Ltd.

The firm has been making for many years the valve illustrated in Fig. 15, which is very similar. The contour of the stopper can be varied to give the required " characteristic " or the relation between valve travel and area of aperture. In Fig. 16 a variant is shown in which the contour of the seat is altered to give the required characteristic. It results in a more uniform unbalanced load on the stopper throughout its travel.

No valve of type 2 as large as that illustrated in the paper has ever been built by the firm. But it has recently started to manufacture a similar kind of valve, see Fig. 17.

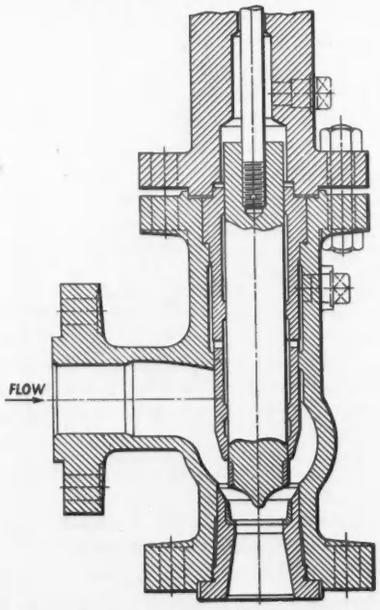


Fig. 16—Variant upon the type 1 valve to give more uniform unbalanced load on the stopper—Blakeborough

It will be seen that there are cylindrical extensions beyond the two mating surfaces of this double beat valve and that these extensions are pierced with holes. To aid in dissipating energy the holes are all tapped. Valves of this kind are suitable for pressure drops up to 1000 lb per square inch. This type of valve has been made in the U.S.A. for over fifty years and therefore antedates the N.E.L. design. However, the N.E.L. design is suitable for larger flows. Owing to the graduation in the size of holes both types of valve are well suited for control purposes.

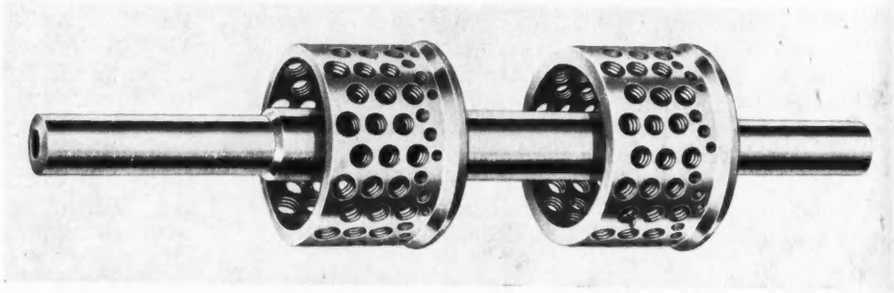


Fig. 17—Valve utilising the principle of type 2 valve—Blakeborough

In the case of the type 3 valve no situation has come to the firm's notice since the publication of the paper for which valves of this kind would have been appropriate. Most control valves are designed to give minimum possible head loss when in the fully open position, so that the energy is dissipated by throttling rather than by surface friction.

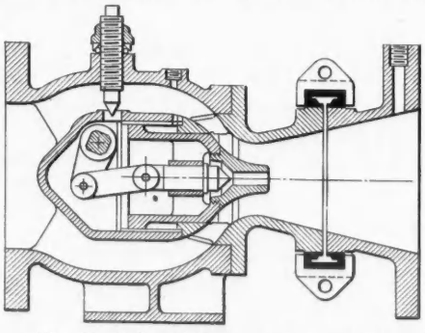


Fig. 18—Valve similar to type 4 made by Blakeborough

A valve of this type would have too limited an application to justify the work that would have to be done in development.

As for the type 4 valve there seemed to the firm's representatives to be nothing novel about the N.E.L. design. It closely resembles one of the firm's designs, see Fig. 18. The firm's representatives agreed that by reversal of flow through a valve of this kind cavitation could be substantially reduced. For twenty years or more valves having this flow arrangement have been offered by the firm.

A criticism often made of research papers is that they are too fundamental to be of practical use. By contrast, the present paper seems to this firm, in some respects, too particular to be of general use.

On the general matter of improving the breed, the firm holds the opinion that many of the basic principles on which valves are designed are, to a large extent, already established. Manufacturers are therefore more interested in better ways and means of applying these principles and welcome all efforts, including those of D.S.I.R., in the furtherance of this objective.

On the other hand, many valves act in a protective capacity to plant of much greater value. Thus both user and manufacturers tend to be conservative, preferring a well-tried valve whose qualities (including any defects it may have) are well known to a new design claimed to be better for its purpose but insufficiently proved in service.

TOWLER BROTHERS (PATENTS), LTD., RODLEY

Oil Hydraulics.—This firm was naturally especially interested in the oil hydraulics work of the National Engineering Laboratory. It has found the work of the Laboratory of very real value. Members of its staff often visit the Laboratory and sometimes work there for weeks in succession in connection with the testing of Towler products, such, for example, as new valves. Methods of testing valves have been improved as a result.

The meeting at which Dr. Firth presented the paper had been attended by a member of the firm's staff, and attention by someone in the firm was given to all the publications of the Laboratory on the subject. Obviously enough, unless people did read such papers with attention, no one could make use of them.

On a specific point, the suction tank shown in Fig. 6 improves upon a similar tank described by F. H. Towler in an article in *Machinery* on " Conversion of Presses to the Direct Hydraulic System," July 6 and 13, 1950, and used by this company for many years. The addition of an air-oil separator of the type shown in Fig. 6 would not be suitable for application to reciprocating press cylinders, which cause a substantial change of oil level in the supply tank during each press cycle. A further development, a floating air-oil separator suggested by N.E.L., might overcome this objection, and the use of a device of this type is being considered.

The complaint was often heard that there was not time to study with attention all the papers which were published. Even so it was suggested there was a good deal of unconscious plagiarism. People get ideas but

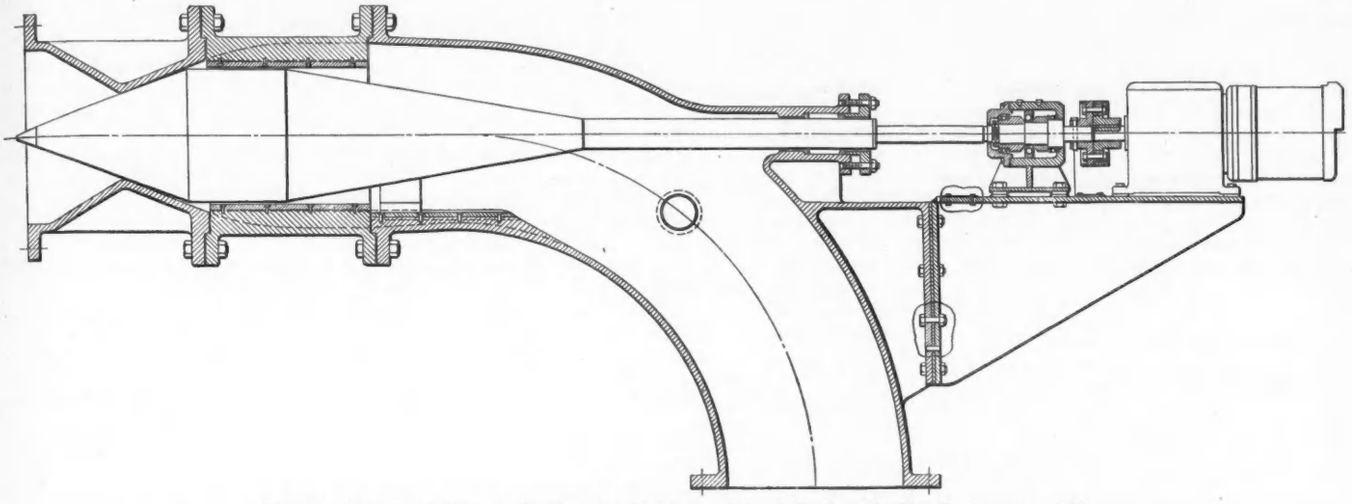


Fig. 19—Spear type valves for heads up to 50 lb per square inch—English Electric Company, Ltd.

do not realise where they have come from; often they come from a dim memory of something heard at a technical meeting or read in a technical article in an engineering journal. This unconscious plagiarism makes it difficult to evaluate research because the credit for the idea is often not given to the Laboratory, which in reality conceived it.

It was also suggested that less use is made of research results than there should be simply out of the difficulty of getting people to admit ignorance. Too many people look up text-books to get a piece of wanted information, and if they cannot find it prefer to assume that the answer is not known. They do not start asking questions, presumably for fear that they may be looked down upon as ignorant. It is thus important that firms should ensure that members of their staffs know who to ask when they are in doubt and where information is likely to be found. Indeed, it is probably more important that people should know who to ask than that they should deliberately try to keep up to date with technical reading. Often enough, though technical directors and heads of departments may know at least something about what a laboratory is doing, more junior people, such as junior designers and draughtsmen, may not even be aware that a firm belongs to a research association. In this matter the research associations have a large part to play in that their research people ought to be well in contact with the work being done at D.S.I.R. establishments.

Interestingly, a remark was made about geography. It was quite clearly felt that N.E.L. would be of greater value to industry in England if it were not sited so far away; the basis of the argument being that it is more valuable in illuminating a problem to discuss it with research workers in the field than to be given, as a consequence of a written or telephoned enquiry, a list of references to consult.

ENGLISH ELECTRIC COMPANY, LTD., RUGBY

Venturimeters and Head Readings.—This firm makes no use of venturimeters for testing hydraulic machinery except in the laboratory, where they are maintained in tip-top condition. Its representatives could not therefore cite any relevant practical experiments, but felt that there was no doubt as to the value of this work. For the testing of large pump-turbines, absorbing 5000 h.p. or more, of which the firm is a manufacturer, free surfaces are almost always available for the purpose of head measurements. The firm's representatives were aware of the effects caused by inlet swirl, but had never had occasion to use the suggested correction method. Our attention was drawn to the fact that the British Standards Institution is considering the desirability of rewriting a section of a relevant specification relating to the placing of gauges. The present requirement is that they shall be placed close to the pump, in fact just in the position likely to yield incorrect readings.

Computation of Flows.—The findings of the paper on this subject have not so far been applied, although it was not difficult to think of cases in which this method would be of value. Reduced costs could arise out of the saving of time in the taking of readings, but since the computation from the readings would be done on a computer, the saving in cost was not likely to be substantial. There was nevertheless great convenience in being able to place a precalibrated arrangement of gauges in a pipeline. The paper is also considered to have a value in its own right as a contribution to the theory of flow.

Valve Design.—The use of a valve of type 3 has been considered, but its somewhat excessive length was a disadvantage for the particular application at that time. It was pointed out that the type 4 valve is very similar to one made by Blakeborough, a point which that firm had already made, see above. Use has been made of valves of type 1, but it is thought that the design was arrived at independently of the work of the Laboratory. No attempt has been made to experiment with the angle of the spear cone. It was felt that this kind of valve would, in fact, be used in preference to type 3, at least for heads up to 50 lb per square inch, for which the valve shown in Fig. 19 has been designed. This compares with a head of 48ft for the valve described in the paper.

Valves of the type 2 have been designed by the firm and used for certain purposes. The English Electric Company's design is illustrated in Fig. 20. Although there is some doubt as to the exact origin of this design, it was probably influenced by that described in the paper. The holes are not graded as in the N.E.L. design, nor are they tapped as in the Blakeborough arrangement.

Oil Hydraulics.—The firm has had a research man trained in this field at N.E.L. It has found the work of the Laboratory very useful indeed.

This firm expressed a high regard for N.E.L. and felt that, in particular, it

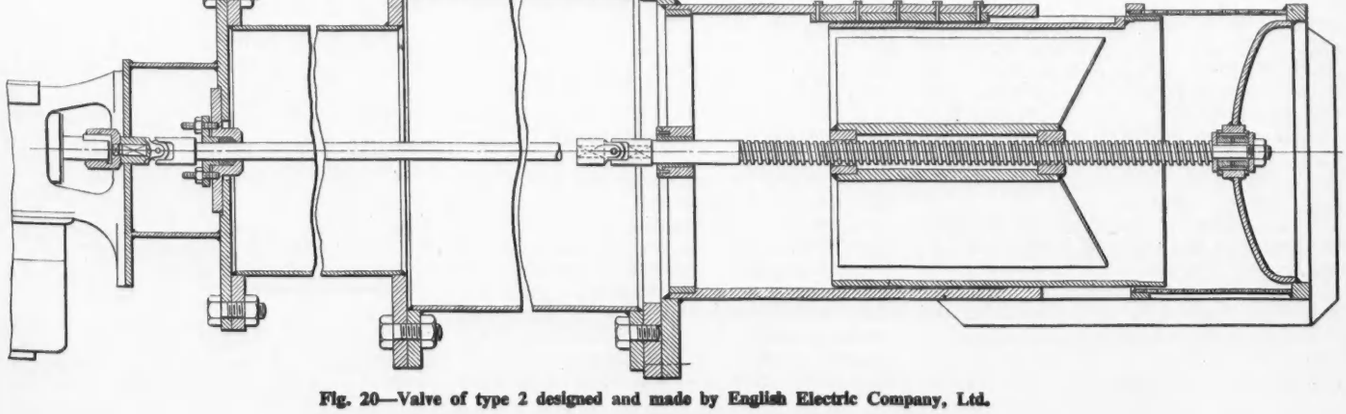


Fig. 20—Valve of type 2 designed and made by English Electric Company, Ltd.

performed an invaluable service in the development of improved measurement methods, and in acting as a centre for collecting, collating and disseminating information.

In recent months the company has been particularly pleased to see changes in the hydraulics policy of N.E.L., giving greater emphasis to practical problems of turbine and pump design and manufacture confronting industry to-day. It is felt that in the highly competitive export market this is the best way in which the needs of industry can be satisfied.

Rover Company, Ltd., Solihull

The use this company makes of N.E.L. researches is just about nil. But indirectly and without its knowledge it may be making much more substantial use of the Laboratory's work. This situation arises because a motor-car firm is largely concerned with machining and assembling parts made elsewhere, with the consequence that it is the suppliers of parts rather than the motor company itself which are in need of the assistance which a research laboratory may be able to give. Troubles are, of course, encountered by motor companies. But most of them are straightforward engineering ones. Many of them are of the trouble-shooting variety where the difficulty is to discover how the trouble is arising rather than to find out how to put the matter right. For example, some years ago unexpectedly rapid engine wear in vehicles used in a tropical territory was eventually traced to the use of oil seals intended to keep the oil in, which, however, operated as pumps to pump in water from outside when the vehicle crossed fords or was driven over water-logged country. The water brought in fine grit in amounts beyond the capacity of filters to control. Under less extreme conditions the oil seals were entirely satisfactory. A change to a different form of seal was the obvious answer. At this firm the view is held that as much as 99 per cent of all problems encountered are of this engineering kind. To assess the real value of a laboratory such as N.E.L., in the firm's opinion it is necessary to consult the makers of motor parts.

Gwynnes Pumps, Ltd., Hammersmith and Lincoln

This firm took an active part in the formation of the British Hydromechanics Research Association and has since been continuously represented on its Council. It has been in contact with the National Engineering Laboratory since its inception.

Venturimeters.—On venturimeters the opinion was expressed that since the firm's meters are frequently examined and cleaned, it would be surprising if calibration would show any significant differences in the coefficient from year to year. Attention was drawn to the problem of the calibration of venturimeters for large flows, as it has usually been necessary in practice to calibrate by extrapolation from results obtained from smaller venturimeters. This, of course, is on account of the difficulty of testing really large meters with an absolute method of measuring the flow. The degree of accuracy is not easy to determine.

Head Readings.—It is felt that most pump manufacturers and users of pumps must by now be well aware of the effects of swirl on head readings, particularly at the inlet. The method of discovering and eliminating the error described in the paper is ingenious. It is no doubt realised that the degree of swirl generated varies with the specific speed of the pump, and that the swirl in the suction of a well-designed pump working at its maximum efficiency duty is usually quite small. It is, too, of great interest to study the flow conditions in the impeller with the return flow swirl phenomenon which occurs at reduced discharge quantities, and researches into that problem have been in hand at the N.E.L. and the B.H.R.A. for some time.

This firm, like others, has experienced the difficulty that site tests do not fully correspond with the results of works tests, the consequence sometimes of difference of lay-out, sometimes of difficulty in obtaining reliable readings. The growing appreciation of the effects of disturbed flow at the inlet and outlet on head readings is likely to bring about modifications of the B.S.S. test code for pumps.

Flow Computation.—This paper is felt to be particularly significant in relation to the measurement of large flows, too large to be measured by the method (used by N.E.L.) of collecting the outflow in a tank and weighing it or measuring its volume. One method which has been used to measure large flows is that of recording the changes of level in docks or reservoirs. But the firm's experience has been that readings of such levels are subject to considerable scatter and that, in consequence, the accuracy attained is no better than that reached by other methods.

It is felt that there is a growing need for better methods than exist at present for the measurement of really large flows because pump sizes are going up. Larger and larger pumps are required; for example, in British power stations pumps of 130,000 g.p.m. each are to be installed, and larger sizes are under consideration.

On Research in General.—It is felt that there is an obvious difficulty in putting over to the unconvinced the real value of research in that it is very seldom possible to define precisely what one gets back for making a contribution to a research association. The object of a research project is to add to the knowledge of a particular subject. It should not be confused with "development," which is the work of the designer and manufacturer, and sometimes the user, who should be ready to take full advantage of the new knowledge which results from research and to develop it to the best practical advantage. Research is seldom conclusive. It usually points to a new field which is ripe for investigation. It is most desirable that all papers coming from research bodies should be easily understood by people in industry. But, in fact, there must also be some abstruse ones which are more in the realm of the physicist or mathematician than the engineer, and also some that are not likely to be of any immediate value in industry. It is very difficult to draw a line dividing those researches which a research body ought to undertake from those it should not. It is not necessarily true in the firm's estimation that researches which approximate closely to scientific curiosity rather than to practice should invariably be conducted by universities. It is, however, to be noted that both N.E.L. and B.H.R.A. keep closely in contact with the universities and that they do transfer some of their research to them.

The point was made that firms ought to have on their staff men able to spend sufficient time on the more abstruse papers to determine their usefulness to other members of the staff in relation to the kinds of problems which the firm needs to solve. One of the more notable virtues of the expansion of research carried out at D.S.I.R. and Association research laboratories is that it stimulates amongst staff at a producing works a more scientific attitude of mind towards the study of their day-to-day problems. Even if, after studying a research paper, it can be declared that it contains nothing new, it is probable that arguments have been put more lucidly and related more conclusively to existing knowledge and that the knowledge has, in fact, been made more exact and reliable.

Another point forcibly made is that the expansion of research in hydraulic machinery is so relatively new that the staffs of research laboratories have still to discover a lot about the jobs they are expected to do. They also need to rediscover in more precise terms many things already known to the designers, to enable them to go on to discover and to illuminate other things about which at present very little is known.

It is not difficult, in the firm's estimation, to point to work in hand which is bound to assist hydraulic engineers to improve their practice. Amongst researches which have already proved their worth can be quoted that on the arrangement of suction sumps by the B.H.R.A. Nowadays, civil engineering consultants and people like the C.E.G.B. almost always prefer to have a model of any important new suggested lay-out for a suction sump tested and, if necessary, its shape amended before it is actually constructed. Then at the same laboratory there has been going forward a research on the operation of syphons. This has attained added importance since syphons are now frequently used instead of valves. The results of a joint research by N.E.L. and the B.H.R.A. on water hammer and pressure surges in pipelines have been published in B.H.R.A.-N.E.L. Joint Report No. 1, "Reflux Valve and Surge Tests at Kingston Power Station." In relation to researches not of immediate practical value, some years ago it was discovered in a research laboratory that if water is free of dissolved

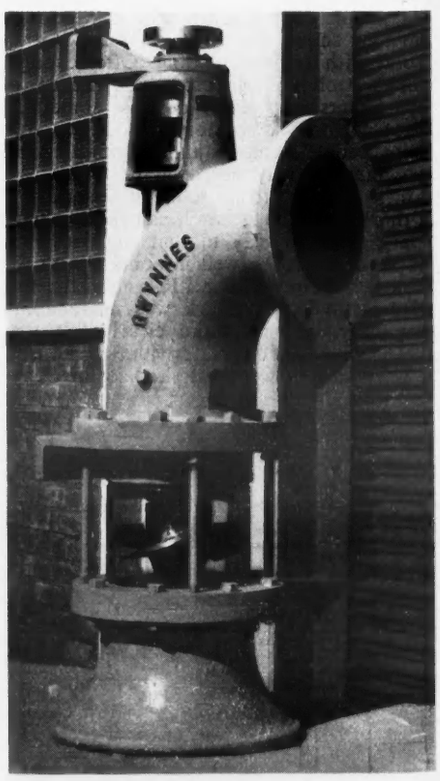


Fig. 21—Research equipment supplied by Gwynnes Pumps to educational establishments, allowing visual observation of the effect of varying blade angles and fitting differing impellers

gas and contains no solid matter in the form, for example, of dust, then it cannot cavitate; water in this condition turns out to have a very high tensile strength! The discovery is apparently of no value to pump manufacturers who have to "make do" with ordinary impure water, but work on this subject has been undertaken by N.E.L. Who would dare to say that no use will ever be found for the knowledge so acquired?

The illustration, Fig. 21, shows an item of equipment used in various forms by the firm for research purposes. It will be seen that there is a "Perspex" section surrounding the impeller. The firm has presented similar equipment to a number of universities and educational establishments. There are facilities for fitting a variety of impellers and for varying blade angles, &c., and to observe the phenomenon of cavitation by the use of stroboscopic light.

Metropolitan Water Board, London

Venturimeters.—The results recorded in this paper are regarded as rather surprising since frequent tests of the Board's venturimeters have indicated little variation of coefficients. The question is asked as to what extent roughening of the surface of a meter is influenced by the pH value of the water and other such factors?

The remark was made that nowadays far too many technical papers are published, making it quite impossible for any ordinary mortal to keep touch with all of them. It is held that the value of many of these publications is doubtful; and that what seems to be wanted is some kind of filter which could select the good, like the present papers, from the bad; and the more immediately applicable from those which could only have a use some time in the more distant future!

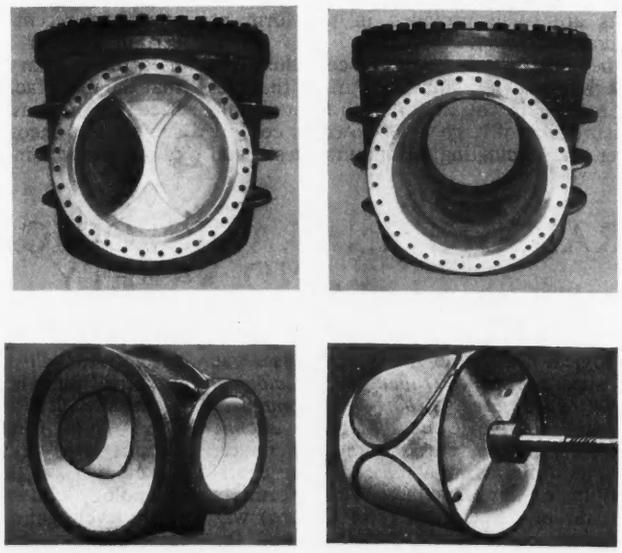


Fig. 22—Harland-Morgan Smith "Rotovalves" of this kind are used in certain circumstances by the Metropolitan Water Board for control of water and air circuits. Notably the valve gives almost wholly unobstructed flow when full open. Final closure is a gradual process inherently so that the valve has an anti-water hammer characteristic

Head Measurements.—The Board's engineers have for long appreciated the difficulty of getting accurate measurements of head. They have also appreciated what the reason is; for experiments were carried out in 1947 to counter the effect of swirl.

Flow Measurements.—For the measurements of large flows the Board's engineers have successfully used the method of gauging the levels of large reservoirs; and they have available a number of channel gauges, orifices, weirs, &c. But, of course, the accuracy of the latter depends upon the accuracy of the original calibration which may not be high by research laboratory standards. Methods of using aerofoils in pipes have also been used with success.

Valves.—For a number of purposes the Board's engineers are not very satisfied with ordinary gate and non-return valves. Use has been made of valves of the Larner-Johnson type, similar to type 4 in the paper. A type of valve—see Fig. 22—originating in the U.S.A., but now made in this country, has been found suitable for certain purposes, such as control valves, automatically operated on large pumping units, also for control on large compressed air circuits, such as wind tunnels, &c. The valve concerned is the Harland-Morgan Smith "Rotovalve" made by the Harland Engineering Company, Ltd., of Alloa, Scotland. It consists of three major components, a body, a plug, and an operating mechanism. The body is slightly tapered internally to receive the plug, which is conical. The operating mechanism actuates the plug axially for seating and unseating so that when it revolves the plug through 90 deg. for opening and closing there is no contact between body and plug. No face to face friction has to be overcome and there is said to be a self-cleaning action. Monel metal seats are fused to the parent metal of both body and plug in such a way that the seats are in contact when the valve is fully open and fully closed. Both body and plug have circular ports so that when aligned in the open position there is free unobstructed flow and the loss of head is negligible. The valve has an anti-water hammer characteristic in that final closure is very gradual.

Research in General.—One of the problems which the Board's engineers have to contend with is that of surging in pipelines. A typical cause of such a surge is a failure of electricity supply leading to the stoppage of a pump. Tests were conducted by the M.W.B. at the Cricklewood station some years ago* and some results are shown in Fig. 23. Test 1 shows the result of suddenly stopping a 6 m.g.d. pump pumping into a single 42in main, with 4¼ m.g.d. taken off before a reservoir is reached. Test 2 shows the result when 11 m.g.d. were being pumped. The pumping units in this station are three in number, two of 6 m.g.d. capacity and one of 12 m.g.d. capacity; and each pump delivery is fitted with a balanced disc type of non-return valve. The violent pressure rise in each case is very obvious.

It is felt that the Board is better equipped to study such problems than is any research laboratory, because the latter cannot command sufficient lengths of water mains, or sufficiently large reservoirs. Apart from the hinged-door type of non-return valve, the ordinary gate valve is often the culprit in creating surges owing to the fact that it is the final 10 per cent of its closure which is really effective in cutting off the flow, resulting in relatively rapid closure even when it appears to be screwed down slowly.

The Board, as a custodian of public money, is cautious about contributing to

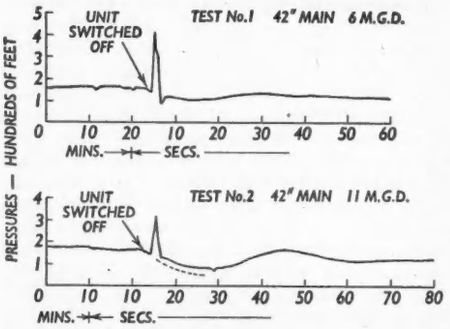


Fig. 23—Two examples of surge pressure tests conducted at Cricklewood pumping station by the M.W.B.

research associations. Research on aspects of hydraulics, it is pointed out, is being done by N.E.L. at East Kilbride, by British Hydraulics Research Association at Harlow, by the Hydraulics Research Association at Wallingford, and by the Water Research Association at Redhill. In addition, much work is done at universities.

The Board supports the W.R.A. and from time to time it has taken its problems to the Imperial College with advantage.

Sperry Gyroscope Company, Ltd.

The representative of this company, without being able to point out any specific change in design brought about as a consequence of the study of any papers published by the National Engineering Laboratory (or any other research establishment) still stressed the value of the work of that body. Records are kept of all the papers published by it likely to contain information useful to the firm, contact is maintained with it, and the Laboratory is consulted whenever problems within its field are encountered. Without its being possible to point to any specific change of design consequent upon the work of the Laboratory it can be regarded as certain that the Laboratory's research work is having an effect.

A quite frequent experience is to find that a problem has been simultaneously studied by a research laboratory and by the firm's research and design staff, with the consequence that alternative solutions are discovered. For the obvious reason that the firm's solution is likely to relate more directly to its particular problem, it is usually more immediately applicable; but the alternative solution is always noted as it can be foreseen that in other circumstances it may become applicable. But, it was suggested to us, by the time it is so applied the real source of the idea may easily have been forgotten. A particular example of such simultaneous study of a single problem, cited to us, was that of a control valve very similar in construction to a steam engine piston valve. The force needed to actuate such a valve, as demonstrated by the work of a research laboratory, can be lowered by paying special attention to the shape of the lands in order to relieve Bernouilli forces. But the firm preferred instead, for its particular purposes, to use the alternative, a simple servo mechanism to multiply the

* *Journal of the Institution of Water Engineers*, Fig. 40, page 146, Vol. VII, 1953.

force available to move the valve. It obviously depends upon the purpose and characteristics of the individual mechanism concerned which of two such solutions will prove the better for its purpose.

In relation to the particular papers mentioned in this article, it was learned that the firm had not been aware of the rate at which the coefficient of a venturimeter alters with the passage of time, and that it intends to examine the implications. But in the matter of swirl it was pointed out to us that all concerned with aerodynamics are bound to have come up against that problem early in their careers so that the firm had nothing new to learn from the paper on that subject. Discussion, however, triggered off the expression of the opinion that in the education of engineers too little stress is laid on the study of dynamic similarity. Not only is there similarity between the formulæ for the flows of air and water, for example, but also for electricity and heat as well. The point can be sustained in many other fields. Recognition of the point not only permits engineers to choose research equipment, which is particularly simple, to simulate problems, which, studied in their own fields, would require bulky, complex and expensive equipment, but also allows engineers to move without difficulty, when taking on a new job, across the boundaries of specialisations.

Another point made was that D.S.I.R. research laboratories ought by their very natures to be able to produce satisfactory and well-thought-out papers for the simple reason that it should surely be an important function of their workers to do so. By contrast the engineer in a production works, even if his job is research, has as his major preoccupation the solution of problems so that the design and production staffs can get on with their jobs. He has, therefore, little time to write up any matter for wider publication once he has explained to those staffs what they should do. It is, in fact, not necessarily part of his function to "write up" any research he may do.

From a wider viewpoint criticism was expressed of a number of research papers which get published on the grounds that they are often trivial or appear to be written by people with no real practical experience of engineering so that the results recorded have no prospect of immediate or even future application. It was, indeed, suggested that a minority of young men enter upon a research (into what matters little) merely to acquire the kudos of having read a paper before an institution or to acquire higher degrees. Such work is always likely to be valueless, because uninformed by any spark of intuition or any real understanding of the underlying engineering problem. If it adds anything it adds only useless lumber to the stock of human knowledge. By contrast more humble workers can and do appreciate that there are certain relationships which are recognised by everyone to be true, but about which precision is lacking; and who proceed to reduce them to precision. That kind of paper, making, as the firm's representative put it, "the obvious, apparent," though sometimes attracting derisive criticism from the uninformed, often proves of very high practical value.

Central Electricity Generating Board

The Central Electricity Generating Board has made use of information originating from East Kilbride and consulted with that Laboratory on several occasions.

Venturimeters.—The Board uses venturimeters for measuring condensate and/or feed water at most modern stations when carrying out tests and especially acceptance tests. Normally the arrangement is to provide facilities for the insertion of a calibrated venturimeter (with its own upstream and downstream lengths of pipe) into the circuit. Normally, such venturi instruments are not provided for each individual plant but are retained by the test department and inserted as and when required for test. This provides the opportunity of recalibrating each venturi and its associated pipe immediately before each particular trial, and the calibration is normally undertaken at one of its own test centres. A range of venturi tubes of certain standard sizes is carried so as to provide for the largest turbines now being installed.

Cooling water, whether sea-water or from cooling towers, is not normally measured on a venturi tube, but the rates of flow are calculated by indirect methods, such as heat rejection to the condenser. It will be appreciated in this connection, however, that the cooling water flow to the present range of turbines is extremely large and in fact the ducts are often provided in the form of concrete culverts.

The Board has, however, consulted the East Kilbride laboratories during the last few months in connection with the accurate measurement of large water flows for cooling tower and circulating water pump tests, and its publications and the collaboration received have been of considerable assistance.

Computing Flows in Pipes.—This point is probably covered by the comments in the preceding paragraph where the pipe or flow of water being considered is extremely large. It is thought that it would be extremely difficult and costly to make provision for the insertion and removal of the measuring annulus mentioned in the relevant paper.

Valves.—The paper produced at East Kilbride was, it is thought, probably intended for hydro-electric work for which the Board has very little application in England and Wales. In addition, it was probably intended for cold water conditions and, except for control valves in hydro work, there would be little application for this type of valve in power station practice. It may well be, however, that much of the information contained in the paper has been utilised by the manufacturers who produce the wide range of valves required in power stations.

Oil Hydraulics.—The problem of the aeration of oil has, of course, been encountered in steam turbine oil systems, but the present designs do provide the separation required and no difficulty has been experienced in recent years on this score. A certain number of oil control circuits are used for auxiliary control and it is probable that the manufacturers concerned have taken heed of the East Kilbride reports on this subject and incorporated some of the fruits of the research into the design submitted.

TRAINING IN RADIOLOGICAL HEALTH AND SAFETY

A REPORT on the training of radiological health and safety specialists was published last week (*Training in Radiological Health and Safety: Report of a Committee appointed by the United Kingdom Atomic Energy Authority*, H.M. Stationery Office, 5s. 6d.). This committee, under the chairmanship of Sir Douglas Veale (formerly Registrar of the University of Oxford) was set up to consider the national need for specialists to deal with the health and safety aspects of the use of ionising radiations and radioactive substances. The increasing use of radiations for peaceful purposes has created a shortage of these specialists; and the report makes recommendations about the kinds of experts needed and their training. It is at present being studied by the United Kingdom Atomic Energy Authority and the government departments concerned.

The report describes (Chapter II) the kinds of work involved in achieving radiological health and safety, and the kinds of training needed. It then reviews (Chapter III) the present position in this country, and discusses the responsibilities in the health and safety fields of government departments, local and public authorities, hospitals and the medical profession, and nationalised and private industry. An attempt is made to estimate the total number of trained people required during the next ten years.

Methods of training for radiological health and safety staff at three levels are considered (Chapter VI). At the top level, university post-graduate courses have already been set up to give a wide training—overlapping the boundaries of medicine, biology, physics and chemistry—to selected graduates in science or medicine. There are courses in the universities of London and Birmingham, and Edinburgh University is planning a course to start next October. The committee believes that these courses, when fully developed, will be sufficient to meet the need for twenty or thirty top-grade specialists a year.

It is recommended that similar courses of a rather less advanced kind should be set up at two or three colleges of advanced technology (Chapter VI). At a somewhat lower level again, a scheme is suggested for introducing certificate courses at technical colleges in the autumn of 1961 (Chapter VI). The idea of a national training centre is examined (Chapter V), but the committee considers it unnecessary, and recommends that the existing educational system should be used to provide the sort of training that is needed.

To make the best use of specialists, the committee recommends (Chapter IV) that a national radiological advisory service, with regional centres, should be set up under the Minister for Science. This service would be able to give advice to organisations (such as firms making use of radioisotopes) without full-time health and safety specialists of their own. It would be available to give expert help in the case of an accident involving possible radioactivity hazards. It would also provide such services as processing the film badges which are worn by all workers who may be exposed to radiation.

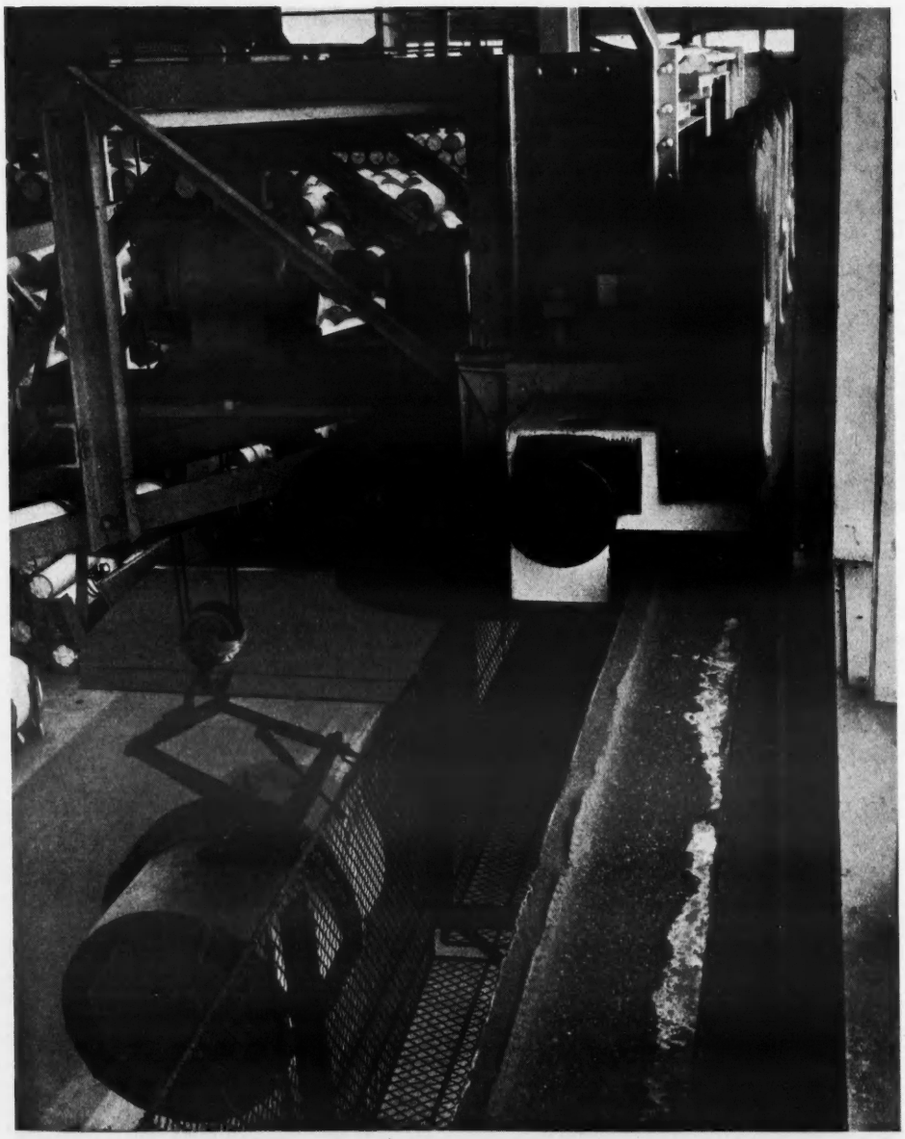
The report also recommends (Chapter VII) that all medical students should be given some knowledge of radiological health and safety in their undergraduate training, and that a course should be included in the curriculum for the Diploma in Public Health, Short residential courses for managers, administrators, medical officers of health and other professional workers are also proposed, as well as books, films, articles, and radio and TV programmes for the information of the public (Chapter VII).

Rubber-Tyred Travelling Crane

The absence of any suspension causes the travelling crane to be designed largely to withstand shock loading in the travel mode and to make severe demands on its supporting building. The use of rubber tyres can not only overcome these disadvantages, but also facilitate steering the crane. The development of steel-cord tyre construction allows comparatively heavy loads to traverse uneven and even non-linear tracks.

TRAVELLING cranes and similar heavy plant have for long travelled along rails on steel tyres. This construction has given rise not only to one of the most characteristic of industrial noises but also to many serious problems. The steel wheel sustains severe acceleration when it meets any irregularity in the track, such as a rail joint, and these jolts both stress the structure severely and tend to throw the crane off its ordained course. But the steel tyre has extreme lateral stiffness, and a very small imposed slip angle can build up a side thrust capable of forcing the flanges up the rails or at least inflicting heavy wear. These characteristics mean that only an accurately straight and level track is satisfactory, while the adverse loading applied by the crane renders it difficult to provide and maintain such a track, particularly in overhead installations. One technique for relaxing these limitations that has been applied in Germany is to guide the crane in azimuth by separate wheels rotating in the horizontal plane ; while this eliminates cross-binding, however, it does nothing to ameliorate shock loading on crane and track.

A fundamental attack on these problems was proposed in 1955 by W. S. Atkins and Partners, namely to use rubber-tyred wheels which would be unaffected by irregularities and could be steered without invoking more than relatively small self-aligning torques. The first application of this technique has been made at the Aylesford Paper Mills of the Reed Paper Group, where two 2-ton travelling cranes in a building only five years old had suffered severe flange wear and were causing the structure supporting the rails to crack and collapse. The cranes are utilised continuously for six days each week, and it was required to restore efficient operation with a minimum of delay. Hence it was desired to run on the concrete path to which the rails for the original cranes were bolted without making special efforts to improve it, and so the concept of a wheel able to " swallow " irregularities was pressed to its conclusion and pneumatic tyres were specified. The use of pneumatic tyres for such heavy duties is possible only because of the development over the last two decades by the Michelin Tyre Company, Ltd., of tyres with which far larger deflections of the side walls are tolerable. In the conventional tyre, the amount of reinforcement (ply rating) in the side walls is necessarily almost the same as that under the tread, and the latter, in order to give satisfactory stability to a road vehicle, is high : thus the casing tends to be stiff and only a small deflection under load is possible without the tread in contact with the ground being distorted. (In road vehicle use, the undesired stiffness causes the maximum sustained speed dictated by heat generation to be low.) The Michelin radial cord tyre has only one ply in the side wall, the stiffness of the tread being provided by circumferential layers of woven steel fabric. Since these bands maintain their flatness in cross-section against the tendency of the air pressure to form the tread into a dome, the flexural strength of the tread is less and an elongated and virtually rectangular contact patch results.



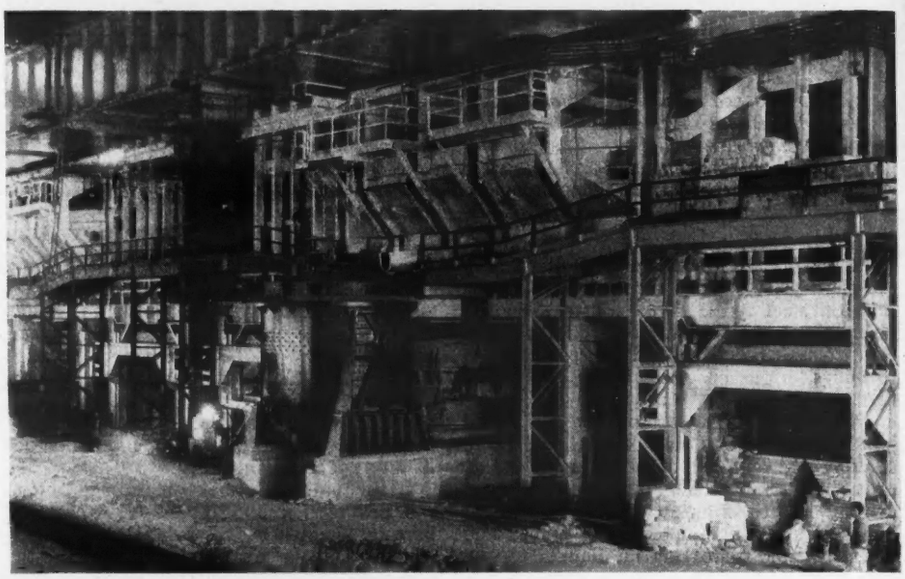
End carriage of overhead crane, showing the five pneumatic tyres, one of the two solid-tyred guide wheels, and the 7½ h.p. drive motor. The radial cord construction of the load-carrying wheels is advertised by the exact reproduction of the tread pattern in the loose sand in the foreground

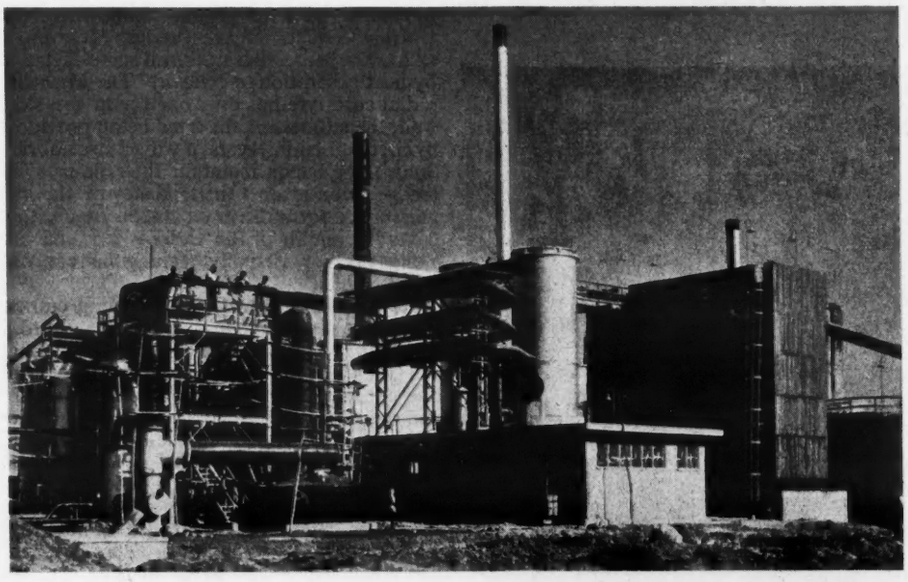
New end-carriages for the existing cranes were built by Strachan and Henshaw, Ltd., and proved feasible on a test track including a 1½in step and a non-linearity of 4in in one column span ; an accelerometer which had registered 10 *g* when the steel-tyred crane hit a rail joint was unable to detect the presence of the step. The new carriages have improved the ride so significantly that the travelling speed has been raised from 300ft per minute to 360ft per minute by reducing the " padding " resistances between the rotor winding, and a further increase to the high value of 400ft per minute is considered feasible. The steering qualities of the carriage, with two guide wheels at each end, are sufficient for it to work satisfactorily with one of the two driven wheels completely removed. To increase the stability of the crane, the two induction motors driving the end-carriages are electrically synchronised by connecting the slip-rings; this is possible because, with the stabilised tread tyre, the effective rolling radius remains closely the same under varying loads, so that the wheel speeds at each end are the same under asymmetric loading. The tyres are 7·00 × 20 " X " Zigzag, inflated to 110 lb per square inch and rated at 45 cwt at 6 m.p.h.—the road rating for these tyres is 26½ cwt at 85 lb per square inch up to 60 m.p.h. The guide wheels are solid tyred, being those of a " Centurion " tank. A Dunlop disc brake system is fitted ; dual master cylinders are used, each cylinder braking one of the wheels on each end-carriage.

We recently observed these cranes in operation after six months intensive use ; outstanding was their silence, the hum of electric motors and cable sheaves being audible when the crane was travelling. The amount of tyre wear so far experienced suggests that tyre life will be of the order of a decade with stabilised tread tyres.

Progress at Durgapur

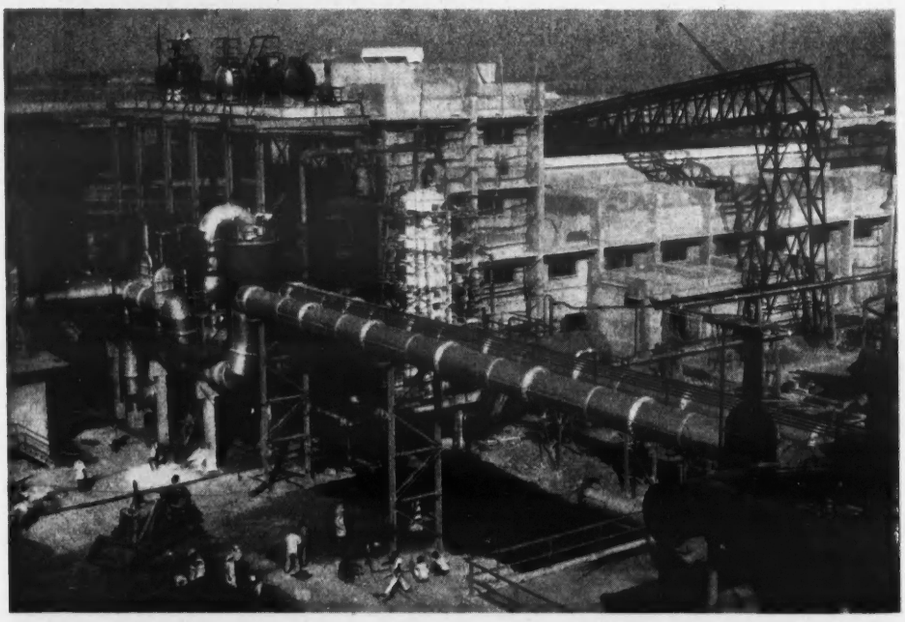
In our issue of January 8, we described the first stage of the Durgapur iron and steel plant in West Bengal. The plant is being built and equipped by Indian Steelworks Construction Company, Ltd., a consortium of thirteen British firms, the estimated total value of the contracts being £105 million. The second stage is now nearly complete and, last week, steel production started when the first open-hearth furnace in the melting shop (RIGHT) began operating. Eventually, there will be eight open-hearth furnaces, seven of 200 tons capacity and one of 100 tons for the production of special steel ; they are being supplied by The Wellman Smith Owen Engineering Corporation, Ltd. A typical charge for the 200-ton furnaces consists of 70 to 80 per cent molten iron and 20 to 30 per cent steel scrap, together with small amounts of iron ore and fluxes. Each furnace is equipped with a waste heat boiler. The second 200-ton furnace is also ready to begin operation and the third is expected to be complete in a week or two.





Other units at Durgapur which have recently been started up include the sulphuric acid plant and the sulphate of ammonia plant, both of which have been built by Simon-Carves, Ltd. The sulphuric acid plant, LEFT, which forms part of the coke oven by-product plant, is capable of producing 60 tons of sulphuric acid a day, and, it is stated, has already reached its rated capacity. Rock sulphur of high purity is used as the raw material for acid production. The process of manufacture involves burning the sulphur to produce sulphur dioxide gas, which is then converted into sulphur trioxide in the presence of a catalyst. The sulphur trioxide is absorbed in sulphuric acid which is then diluted with water to produce high-purity sulphuric acid of 98½ per cent strength. In the process of production, surplus heat from the burning of sulphur and the catalytic conversion of sulphur dioxide to sulphur trioxide is utilised to produce approximately 5000 lb of steam an hour ; part of this steam is used in the sulphuric acid plant for sulphur-melting and other purposes, the rest being passed into the steel works steam mains. The sulphuric acid produced will be used primarily for the production of sulphate of ammonia.

The sulphate of ammonia plant, RIGHT, utilises the gas available from the coke ovens for the manufacture of ammonium sulphate crystals, which can then be put on the market as a fertiliser. The plant has a rated production capacity of 57 tons of ammonium sulphate a day from 2,000,000 cubic feet of gas. These crystals are formed in a saturator bath and are then ejected automatically to a continuously discharging centrifuge machine for preliminary drying. They are then fed by conveyor to a rotary hot air drier and are automatically weighed into the bags, ready for sale to consumers. Automatic control is achieved by a comprehensive system of instruments.



Iron and Steel Works Production Control

The annual meeting of the Iron and Steel Institute has been held in London this week. It began on Tuesday, when Mr. W. F. Cartwright was installed as president. In his presidential address, Mr. Cartwright dealt with production control in an integrated iron and steel plant, commenting in particular on experience at Port Talbot. Extracts from the latter part of the address are printed here.*

Oxygen Control

THE oxygen control which has been established (at Port Talbot) presents a somewhat different problem from that of the normal gas control. There is only one supplier of oxygen, although the plant consists of two separate units, one of 100 tons per day and the other of 200 tons per day, to which two further 200-ton per day plants are to be added. The main users of oxygen in order of priority are the basic Bessemer plant, the scarfer and the open-hearth shops. The oxygen controller has to exercise discipline over twenty-four open-hearth furnaces, many of which may be asking for oxygen, when there is only enough available to blow one furnace. This control is, at the moment, in the early stages of operation. No remote indicating flow instruments are yet in operation, and control is entirely by telephone and pressure indication. Since the rate of consumption is frequently far above that of the rate of supply, receivers have been installed and much calculation has been done to find out the number of receivers necessary to avoid blowing-off to waste and yet avoid departments being short of oxygen when they require it. Since the use of oxygen is always increasing, particularly with the development of basic bricks in the open-hearth shops, a continued shortage is visualised for some time to come, making the job of oxygen controller a difficult one, and as yet no formalised control system has been developed. At the moment the oxygen control is carried out by the gas controller in the gas control room.

Materials Stock Control

One of the most important production control matters is that of stocks. It used to be said that the cheapest method of stocking coal was in 10-ton railway wagons, and there is no doubt that there is some truth in this observation if the period of stocking is to be a short one ; however, control of the main raw material stocks (coking coal, coke, pig iron, scrap and iron ore) is one of the chief headaches of any production control department in a large iron and steel works. Inherently, coke ovens do not like being raised and lowered in production. If raising or lowering is carried out, over a sufficiently long time, damage can be avoided, but coke ovens will unquestionably give of their best if kept at a steady rate of production. Blast-furnaces do not always work according to plan. Even the plans must include a reline, and thus it is almost impossible to avoid a fluctuating coke stock, depending on the working of the blast-furnaces and the relining programme. The coking coal problem is not as simple as the steady rate of operations of the coke ovens would imply. In the first place, the South Wales coalfield is made up of a very large number of pits ; this is illustrated by the fact that in the first six months of 1959 the coke ovens at Port Talbot received 105 different grades of coal. Roughly, they are divided into high, medium, or low volatile, and washed and unwashed, but the stocking problems of storing coals of widely differing characteristics can be immense, and these problems are accentuated by the fact that every holiday brings a wide variation in the supply of coal. Strikes, shortage of railway wagons, and bad weather, may also introduce separate problems.

To control coke quality, there is no doubt that a reduction in the number of coals would assist matters, for with two coke-oven plants, one with a washery and one without, and large variations in the rate of supply, whether to stock or to hold in wagons becomes a question of importance and one that is difficult of solution. Long-term planning is necessary to ensure that coals are always turned over, and yet that adequate stocks, which in the case of Port Talbot mount up to 100,000 tons, are built up before each summer holiday in the coalfield. We have found that it is difficult to reduce the number of coals, which is important if our washing technique and therefore our coke quality are to improve, unless we have a considerable stock of coal always on hand ready to bridge any variations in the outputs of the various collieries. This requires a careful analysis of the savings that can be effected by carrying larger stocks to compare with the losses obviously incurred by double handling or standage charges. It has been found that the picking up of any considerable quantity of stocked coke immediately results in a deterioration of blast-furnace performance, making it clear that it is essential to have not only a good method of stocking coke and recovering it, but also an adequate screening plant, which can screen stocked coke when recovered. In order to get good results over a period from any coking plant, it is necessary to have a long forward plan, taking into account colliery holidays, any planned stoppage of the plant, such as Christmas, and relining of blast furnaces, and this involves a proper coal stocking plant, with a method of keeping the various grades of coal separate ; such a plant must be capable of receiving coke at the full rate of output of the coke-oven plant, and of recovering it and screening it at a high rate.

If real production control is to be established over pig-iron manufacture, adequate ore stocking, screening, and crushing facilities must be available, together with sintering facilities, in order to use all fine material. Only recently at Port Talbot have these been available but, as in the case of the coke ovens, multiplicity of ores has rendered the task extremely difficult, and it is to be hoped that in the future it may be possible to operate foreign ore plants with large quantities of a few ores, rather than smaller quantities of many ores. Port Talbot is not laid out as anybody would lay out a blast-furnace plant to-day, starting with the knowledge of the desirability of crushing, screening, and sintering ore, the use of self-fluxing sinter, and the high percentage of fines now present in most foreign ores. As a result an extremely complicated raw-material layout has emerged and, in the early stages, it became obvious that once again some form of control would be necessary, The so-called raw materials controller has in his office a mimic diagram, showing the operation of the plant at the various points at which ore is received, treated, and consumed. There are five transporter unloaders with two ship berths ; two tipplers for home ore, limestone, and purchased coke ; an unscreened ore stock, a screened ore stock, and a fine ore stock ; primary and secondary crushing and screening plant ; and three sinter plants. When to this complexity is added the fact that there are in general use twenty-four different ores, and two different kinds of limestone, it will be clear that the operator has a good deal to think of, including a hundred different belts, covering a total distance of 13 miles.

This is excessively complicated, and endeavours are being made to eliminate certain belts, cut down the numbers of ores, and produce self-fluxing sinter requiring no further addition of limestone. The control is in operation twenty-four hours a day, and actions must be rapid to ensure that the plant is kept operating. The controller may be confronted by the fact that two ships have arrived alongside, both containing ore which requires screening, or by the fact that when screening an ore making such fines, the space available for the fines of that particular ore in the fine ore stockyard is nearly full. He must be capable of reaching a quick decision under such circumstances.

Scheduling and Production Department

The largest existing control is that of the scheduling and production department. The object of this department is to schedule and progress customers' orders through all processes, from the steel plant ingot production to the finished rolling-mill products, in accordance with the order delivery date, the quality, and the quantity. This schedule is governed not only by customers' requirements, but also by the necessity of scheduling in accordance with efficient rolling-mill practice. Customers' orders pass from the sales department to the order control department, who issue the orders to the mill in accordance with the sales department plan. The first step in the mills scheduling department is to mark the order with the metallurgical routing programme required. The order is then passed to the department carrying out the calculations necessary to convert the customers' order into hot-rolled coil weights and dimensions. The order form, with this information upon it, then passes to the hot mill scheduling department, which computes the coil sizes into slab and ingot dimensions to achieve the best possible yield. The steelmaking plant receives from this department orders for steel grade and ingot size and type to achieve the hot mill schedule.

The information regarding steel casts as they are made passes back through the ingot controller to the soaking pit planner, who schedules the ingots, and then through the soaking pits and slabbing mill and up to the shearing stage. The slab shear operator then passes back to the hot mill scheduler the lists of slabs actually sheared, and with this information the hot mill scheduler builds up his records of slabs in stock from which he makes up his actual hot mill rolling schedule. On all hot strip mills this must invariably begin with narrow strip, widening out rapidly to a given maximum and slowly returning to a minimum width in

* Steel Company of Wales, Ltd.

order to compensate for heating up of the roll and roll wear.

A certain amount of mechanisation has already been introduced. In the first case, the sales department, by combining the order with punch tape carrying common information, produces punch tape from which punch cards can be produced. This punch tape also produces an order card which is the common form used in connection with the customers' order throughout its life. The punch cards are then fed through a machine to produce every week a list of all orders so sorted that they appear in order of descending width and gauge, and in separate qualities. This is the basic information from which the hot mill scheduler prepares the mill schedule. In order to deal with failures to roll, the punch card goes to the mill together with the order. In the event of its being rolled, the card is destroyed ; otherwise the card is returned to the office to take part in the next week's run-through.

It is not possible in this short address to explain the complexities of this whole system. At a level of production of about 2,500,000 tons, it became clear that it was necessary to install a more formal production control department for the works as a whole. This is now going into operation. The object of this department is to assist general management in achieving improved control in detail over the immediate production situation by using up-to-date information regarding the situation throughout the works, and a more accurate insight into future production trends by using past experience, as well as plans for the future in predicting the works situation for a considerable time ahead.

The production controller is responsible to the assistant general manager in charge of operations. The first step of the production controller is to ensure that he is in possession of accurate and up-to-date information about what is going on in every department. This involves the supply of regular returns from each department, and also immediate information when any change takes place, such as unexpected breakdown, failure of a ship to dock, or anything that might disturb the pattern on which forecasts and planning have previously been made. With such information, the production controller is able to make an accurate forecast of the output of each section of the plant and of the requirements of raw materials. He makes an accurate forecast of the expected production of each department for a week ahead each Friday.

A twelve-week forecast is also published every Friday, the previous week being taken off and one week added, and a long-term forecast five years ahead is also made, the first year being in quarters and the remainder in half-years. When preparing these reports, the controller has to consider short-term variations such as rebuilding of open-hearth furnaces, normal planned maintenance for the various mills, and minor breakdowns or overhauls throughout the plant, but he also has to consider, in ample time, the variations that will be brought about by holidays, whether they be for one part of the works and not another, such as the Christmas stop, or one part of the company and not another, such as the tinplate division stopping when the steel division keeps operating, or holidays of suppliers and consumers, such as the National Coal Board and the press works. Ever since the start of operations at the Port Talbot strip mill, the works has operated under conditions of full output. The production controller's functions will have further complications at any time when demand falls below capacity and, as yet, no experience in this field exists.

Conclusion

One of the most important functions of the production control department is to see that realistic yield and consumption figures are used in forecasting, and not those which the departmental manager would like to think were his usual achievement. The state of production control we have now reached is well known to be merely a first move in the direction of more mechanised control of the whole operations of an integrated iron and steel works. For instance, it is already well known how to run all the operations of a slabbing mill from punched cards suitably prepared. Very recently the Great Lakes Company has ordered an automatic control system for its new 80in hot strip mill which it is stated will control all the operations from the time the slabs enter the mill until they emerge in rolled coils, using 200 key points along the route to feed information back to a computer, which will so control the mill that the correct gauge and width is consistently produced.

At the Homestead works of the U.S. Steel Corporation, the whole scheduling and production control from receipt of customer's order to shipping the finished plate is being carried on one large computer installation, an I.B.M. type 650 Tape "Ramac" system, having a magnetic drum of 20,000 digits, four "Ramac" units of 24,000,000 digits, and six types of twenty-nine magnetic tape units of 150,000 records, each of thirty characters.

Ideally, the system of the future will be such that the sales department will have a list of every product the company can produce and a display from which they can deduce the delivery they should quote for any order. They should also have continuously available the expected date of delivery and position in the plant of any order already taken. In order to achieve this ideal result, information must flow to a central communication centre from every piece of plant which may affect the production programme. In some people's minds is the thought that this information should flow automatically so that, for instance, the output of a flying shear cut-up line would be recorded at the central communication centre from the machine without human intervention. Others feel that the capital cost of such an elaborate communication system will never be justified. However, the control of major units in the mill direct from punched cards is clearly possible now and, if this is so, the outputs of all major units can be unquestionably received at the communication centre immediately, so that it appears to be a question to be decided on the merits of each piece of plant whether to cable the recording mechanism direct to the communication centre or to continue to transmit information from time to time from records.

Discharge Lamp Production Development

The close association of a development laboratory and a lamp works has facilitated the improvement of production by new processes as well as leading to higher lamp efficiencies.

TWO steep rises in the efficiency curve of the "Osram" 5ft 80W fluorescent tube reflect the introduction after the war of halophosphate powders in place of beryllium, and the recent development of new processes for grading the powders and coating the tubes. The latter processes were demonstrated during a visit on April 28 to the "Osram" lamp works of The General Electric Company, Ltd., at Shaw, Lancashire, which is now the company's principal discharge lamp factory and the site of its main discharge lamp development laboratory.

Particle size grading of phosphors has been introduced because it was found that the ultra-fine particles produced during milling lowered tube efficiencies by about 10 per cent. A vibratory hopper feeds powder into water which is pumped, with the powder in suspension, to two conical cyclones. In the first of these the coarse particles (larger than 20 microns) are flung to the outside and drain downwards for remilling. The finer particles, remaining in the middle, are carried upwards to the second cyclone, where the fines (2 to 20 microns) are separated for use in tube manufacture, while the ultra-fines are discarded.

At present this powder classification process is being used for the powders of 5ft tubes in the daylight, natural and warm white colours. It has resulted in an increase in efficiency of the 5ft 80W daylight tube from 56 to 64 lumens per watt. The efficiency curve has an upward trend which, in the light of current knowledge and work in the development laboratory, makes it reasonable to forecast an eventual efficiency as high as 90 L/W.

The suspension of the powders in water makes the use of a water-soluble binder almost essential, and the discarding of the nitro-cellulose used previously has removed the need for special fire precautions and fume extraction. On the other hand, it raised a drying problem, but this has been overcome by the design of a conveyor (Fig. 1) in which heated air is blown downwards through the tubes from overhead ducts as they come into position below. Air is delivered to the ducting by an axial-flow fan and the heating consumes 14kW. A final baking process takes place in the oven, seen on the right of Fig. 1, and in front of this is the roller conveyor section on which the ends of the tubes are cleaned by the automatic insertion and withdrawal of rotating brushes.

In another section of the fluorescent tube plant the coating of cathodes was seen, the coils being expanded before dipping and then contracted to ensure that the maximum amount of emissive material is picked up. Attention was drawn also to the present method of applying the external conducting stripe to the tube outer wall between the lamp caps to assist starting by maintaining uniform potential distribution. This is now "painted" on in silver nitrate as the tubes move along a conveyor under the pens, after which the stripe is baked and remains permanently deposited. Connection between stripe and cap is made by applying a spot of silver paste and then curing by infra-red lamps.

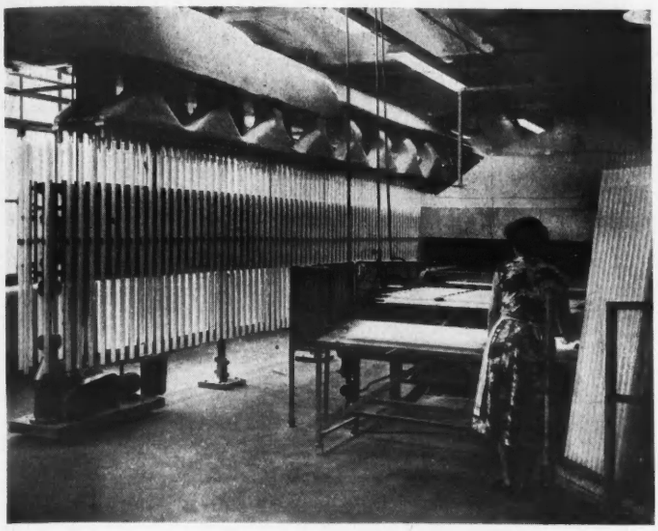


Fig. 1—Drying fluorescent tubes on a conveyor after coating with phosphors in a water-soluble binder

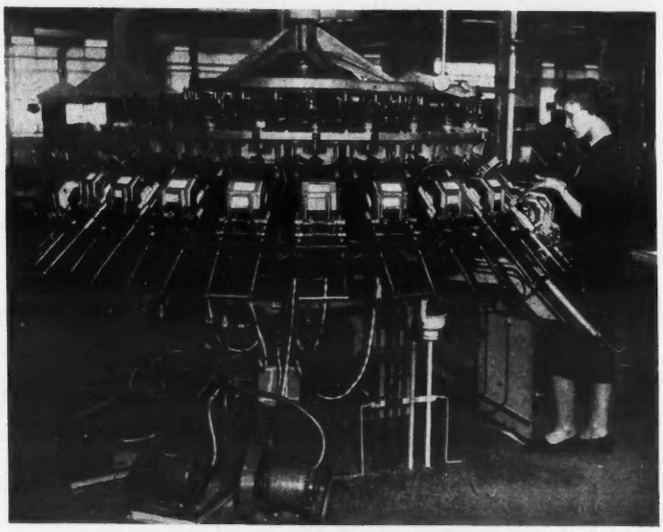


Fig. 2—Rotary pump for exhausting and filling mercury lamps

Improvements have also been made at Shaw in mercury lamp production, the quartz tubes being now produced automatically at the rate of eight an hour, as compared with four an hour by a skilled blower. The pumping of these lamps has also become an automatic process by the development of a rotary pumping machine which is stated to be the only one of its kind in Europe for performing the whole operation of pumping mercury lamps (Fig. 2). In this machine the lamp pumping stems are automatically inserted into the rubber connections to the pump, and the lamps are heated to 1200 deg. Cent. while enclosed in the individual ovens seen in the illustration. After baking and flushing with argon, each lamp reaches the mercury feed point, where a drop of mercury is released. Between 120 and 200 lamps an hour can be filled by machine as compared with thirty an hour by hand.

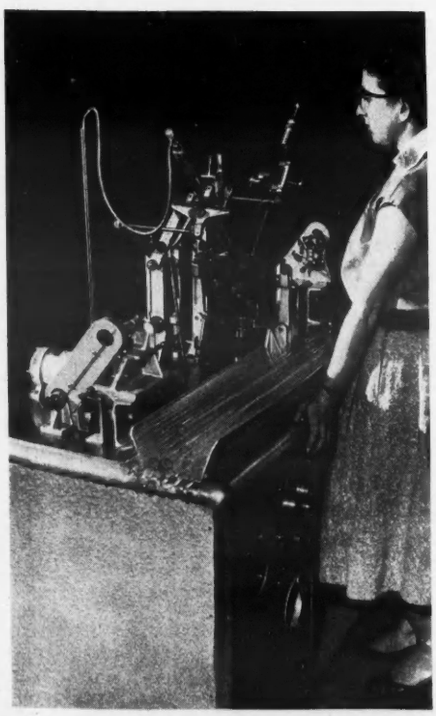


Fig. 3—Automatically controlled heating and bending of "U" tubes for sodium lamps

The sodium lamp section of the factory shows similar progress in speed of production. We illustrate (Fig. 3) an automatically controlled machine for forming the "U" bend in the discharge tube. The operator assesses the time required for the operation by the thickness of the glass and sets a process timer appropriately, after which the heating and bending take place automatically. This has enabled sixty "U" tubes to be produced in an hour by unskilled labour, compared with eighteen an hour by hand bending.

A new pump for sodium lamps was demonstrated in which a complex sequence of operations is performed by electromagnetic devices energised in turn through contacts actuated by a rotating camshaft. The processes involved are exhausting, cleaning of cathodes, cleaning of glass by baking (followed by forced cooling), and melting of sodium by eddy current heating in readiness for injection, which is effected by the operator pressing a push-button.

In the development laboratory the formation of "dimples" and "flats" in the tubes of sodium lamps as a means of preventing sodium migration was illustrated and a linear sodium lamp with a luminous efficiency of 100 L/W was shown. Much of the work of the laboratory is reflected in the production processes already described, but among work still at the laboratory stage may be mentioned the development of an extra-strong cathode construction for fluorescent lamps used in transport vehicles. A cathode was seen under study while being vibrated at 110 c/s. Many cathodes to-day show resonances around 90 c/s—a frequency met in aircraft and trains—and work is well advanced on a new cathode design which has no major resonances below 200 c/s.

Transistorised Temperature Controller

We have received particulars from Heating Investments, Ltd., 284, Regents Park Road, London, N.13, of an automatic controller, the "Repitrol B.7," for thermal storage heating systems. The controller, which is built into a normal time switch, comprises an electrical bridge circuit and transistors encapsulated in epoxy resin for stability. It operates in conjunction with a tubular outdoor temperature-sensing element which is virtually invisible on the wall of a building, and is arranged to switch the installation on at appropriate times at night during the "off-peak" electric or other thermal storage period, and also for a mid-day "boost" period according to climatic conditions. The circuit consists of a d.c. bridge, the balance of which is under the influence of the external temperature-sensitive resistance element and a potentiometer driven by the time switch clock which makes one revolution every twenty-four hours. A transistor-amplifier connected across the bridge normally supplies current to hold apart a pair of contacts in the operating circuit

Combined time switch and transistor amplifier for control of thermal storage heating

of a contactor or contactors controlling the heating system. If the bridge approaches balance the solenoid controlling the contacts is de-energised, allowing them to close. The time during which the storage heaters are recharged is thus dependent on outside temperature as detected by the temperature resistance element, and the position of the clock-driven potentiometer, but comes within preset periods selected by the time switch. The effect of the combined action of the temperature-sensing element and the potentiometer is that the recharging period is adjusted economically. When the drop in temperature is small, for example, some time will elapse before the action of the potentiometer balances the bridge and initiates recharging. Adjustment of the balance point and range of the bridge is effected by means of resistor taps.

[Reply Card No. E7751]

MAINLY METALLURGY

by T. Henry Turner, M.I.Mech.E. M.I.Loco.E. A.R.Ae.S. F.I.M.

Links Between Engineers and Metallurgists

The Metallurgical Engineering Committee of the Institute of Metals was recently responsible for organising a session of the spring meeting of that Institute and reference is made later to the technical discussions. Before doing so, however, it is well to recall that the Iron and Steel Institute has an active Iron and Steel Engineers Group. Thus, these two metallurgical institutes have both come to reciprocate the interest which was earlier shown by the great engineering institutions.

There have already been many notable personal links between engineers and metallurgists in the distinguished men who have served as presidents of more than one of the Institutes. Soon after the formation of the Iron and Steel Institute, in 1869, Sir William Siemens served as president of the Institution of Mechanical Engineers, from 1872–73, and later served as president of the Iron and Steel Institute from 1877–79. Others have similarly achieved eminence in both engineering and metallurgy as may be seen from the following table.

Men Who Have Served as Presidents of Both Engineering and Metallurgical Institutions

Institutions of ...	Civil Engineers	Mechanical Engineers	Iron and Steel Institute	Institute of Metals
Founded in	1828	1847	1869	1908
Sir William Siemens	—	1872	1877–79	—
Sir Lothian Bell	—	1884	1873–75	—
Edward Windsor Richards	—	1896	1893–95	—
Sir William Henry White	1903	1899	—	1908–10
Sir John Dewrance	—	1923	—	1926–28
Sir William Henry Ellis	1925	—	1924–25	—
Sir Henry Fowler	—	1927	—	1932–34
Dr. Stanley Fabes Dorey	—	1950	—	1954–55

This list of eight prominent men seems to make apparent that the mechanical engineers have been more interested in metals than were the civil engineers, and that for the first fifty years of its existence the Iron and Steel Institute enjoyed close links with the "Mechanicals" whose interest thereafter became more obvious in the Institute of Metals, for its first fifty years. The two presidents at the head of the above list became famous as designers of open-hearth furnaces and of blast-furnaces. The others are better known for their engineering achievements. Sir William White was indeed outstanding, having been president of two engineering institutions and of the Institute of Metals; in which office, the present writer, who was then a schoolboy, enjoyed the pleasure of being introduced to him.

The swing of interest towards non-ferrous metallurgy recalls how much metallurgists are indebted to the Institution of Mechanical Engineers for setting up its Alloys Research Committee seventy years ago. Its work was guided by Professor Sir William Chandler Roberts-Austen, who at the turn of the century was president of the Iron and Steel Institute and who is commemorated in the naming of one of the constituents of steel, "Austenite." The discussion of the reports of the Alloys Research Committee set the stage for the Institute of Metals, which was formed in 1908 with Sir William White as its first president. For many years thereafter its meetings were held in the lecture room of the Institution of Mechanical Engineers.

Institute of Metals Spring Meeting

Discussion of the many scientific papers, which were presented at the spring meeting of the Institute of Metals in London from March 29–31, began with that by two members of the Aero Engine Division of Rolls-Royce, Ltd., Derby. The paper was entitled "Precipitation Effects in Liquid Aluminium Alloys," and in it the joint authors, Mr. N. D. G. Mountford and Mr. R. Calvert, reported novel experiments with a pulsed ultrasonic technique. These authors' developments in the application of pulsed ultrasonic energy to the study of liquid metals appear to be without counterpart, although some of the radar techniques are well established in the non-destructive testing of solid metals. There were some fifty members present, and the subject evoked a long and appreciative discussion. In presenting the paper, Mr. Mountford said that the problems connected with the production of sound aluminium alloy castings could be divided into three broad classes: gas pick-up and associated porosity, turbulent transfer of metal into moulds, and adverse thermal gradients during cooling which might cause shrinkage faults.

This work has already resulted in the development of a modified melting technique giving better-quality melts for castings. The application of pulsed ultrasonic waves in this way opens up an entirely new field for the investigation of metallurgical problems, with particular reference to those associated with liquid-metal processes. The same simple methods could perhaps be extended to explore the general cleanliness of copper-based alloys, cast irons or even steels, provided that the problem of finding a suitable guide-rod material can be overcome.

The second paper in this first session also dealt with a practical problem encountered in light alloys, "The Embrittlement of Aluminium-Magnesium Alloys by Sodium." It is a precise and fundamental piece of work by two authors, who are associated with the Research Laboratories of the British Aluminium Company, Ltd., Gerrards Cross, Bucks. Dr. C. E. Ransley and Mr. D. E. J. Talbot, the latter of whom presented the paper and the former replied to the discussion, tackled this problem because it is known that the hot-working properties of the high-magnesium, aluminium magnesium alloys are much harmed by the presence of mere traces of sodium, in the order of 0·001 per cent. The authors ascribe the embrittlement to the adsorption of sodium on the internal surfaces generated in plastic flow and consequent modification of the growth of grain-boundary cavities.

Nuclear Energy Metals

The second technical session was devoted to a discussion arranged by the Nuclear Energy Committee of the Institute of Metals, with special reference to a paper entitled "Volume Increases in Fissile Materials on Neutron Irradiation and the Effects of Thermal Fluctuations." This paper was by Dr. G. W. Greenwood, who comes from the Atomic Energy Research Establishment, Harwell, Berks.

As would be expected, contributors to the discussion came mainly from such places as Calder Hall and Windscale, but it was opened by Professor C. R. Tottle of Manchester University. Some of the most instructive contributions came from those who have had practical experience in the metallography of these rare materials and from the mathematically minded theoreticians. With electro-polishing the removal of impurities may result in what appear to be bubbles, in the photomicrographs, and the significant bubbles can be made any size. Moreover, there is a strong psychological pressure on the metallographers to produce bubbles of the right size! Clearly Dr. Greenwood was right when he concluded that this was an experimental subject. Starting from the observation that, when fissile materials are irradiated above 450 deg. Cent. in nuclear reactors, significant increases in volume occur, experiments were made at the A.E.R.E., Harwell, on the effects of temperature variations during irradiation. The results of these experiments were examined. In the range of 450 deg.–650 deg. Cent., volume increases in specimens of α uranium structure are generally greater than in those of cubic structure and are too large to be accounted for in terms of the conventional creep-test data.

Electron Theory of Metals

The third technical session was of an unusual character. Instead of the presentation of papers and discussions by those who had studied the preprints, an "Educational Session" was arranged by the Metal Physics Committee. The innovation was obviously popular with many members of the Institute of Metals because the Hoare Memorial Hall was filled, and the audience overflowed into the gallery. Professor A. H. Cottrell, F.R.S., was in the chair and brief lectures were given by three distinguished theoreticians. Dr. W. M. Lomer, from Harwell, first gave a general survey; he was followed by Dr. V. Heine, from Cambridge, who spoke about recent experimental work, and finally, Dr. J. Friedel, from Paris, spoke of the electron structure of alloys.

The physicists appeared to be in unusual embarrassment for they said that because there were liquid insulators the whole basis of their understanding of alloys was shaking.

Many metallurgists have become familiar with the basic ideas of the electron theory of metals, as laid down in the 1920–40 period, and with the application of these ideas to the understanding of the structures and compositions of certain alloy phases, e.g. electron-compounds. The extension of this work to the alloys of transitional and other more complex metals has proved less fruitful. There are now doubts as to whether one should continue trying to understand this wider range of alloys by more intensely applying the same ideas, or whether to assume that the present difficulties indicate some basic weakness in that approach, in which case an entirely new approach may be needed. The dilemma has been sharpened by the intense questioning of the fundamental theory and by the new points of view that have appeared in recent years. The difference between metals and insulators is now thought to depend on the ionisability of the atoms rather than on the filling of Brillouin zones. Experiments have proved that the Fermi surface, which is not supposed in the old theory to touch the Brillouin zone boundary until the limit of the alpha phase is reached in copper alloys, in fact already touches it in pure copper. This appears to strike at the whole basis of the electron theory of alloys.

New ideas have emerged in recent years about the state of valence electrons round alloy atoms in metals, about the free electrons behaving as an " oscillating plasma," about the electronic structure of transition metals, and about the nature of the valence bonds in solids. It was thus a very timely moment for metallurgists to hear physicists speak of the changes now taking place in the basic theory. Many questions were aired, but it seems to be too early as yet to know what new factors are likely to emerge, or how much is likely to remain of the old theory, or in what directions one should attempt to go forward now to gain a better understanding of alloying behaviour.

Rolling Hard Material

On the third day of the spring meeting the members of the Institute of Metals were given the option of attending one or other of two sessions which were held simultaneously. Programme (A) had been arranged by the Metallurgical Engineering Committee for considering four practical papers on various problems connected with the rolling of hard materials in thin gauges. The first paper, by Professor Hugh Ford and Dr. J. M. Alexander, reviewed the published work on the theory of cold rolling of thin, hard strip and examined the adequacy of the basic concepts from the practical viewpoint. These authors proposed a new theory for predicting the minimum thickness that it is possible to roll, based on elastic conditions in the rolled strip. This must be very welcome because Mr. Hessenberger said in the discussion that a few years ago foil rolling was just a black art.

This first paper from the Imperial College, University of London, was followed by one from the Metal Deformation Section of the Research Department, Imperial Chemical Industries, Ltd., Metals Division, Birmingham. Its authors, Mr. R. J. Wilcox and Dr. P. W. Whitton, spoke of " The Rolling of Thin Titanium Strip," because in the last few years the problem of how to roll thin hard sheet and strip has assumed greater significance as demand has increased for non-standard sizes in metals showing high strength at normal and elevated temperatures. As a result of their experiments they conclude that considerable scope exists for extending the usefulness of conventional rolling mills by the selection of a really good lubricant. By that means, at any given setting of the rolls, the load is reduced and the resulting thickness is less. They show that for the cold rolling of hard, thin, titanium strip reductions of load up to 60 per cent are possible, and for thinner strip than that tested still greater economies are indicated. The choice of lubricant was found to be more significant than the prior preparation of the surface of the metal to be rolled. Values of the mean coefficient of surface friction for titanium can vary from 0·032 to 0·18. At the upper limit theory indicates that sticking will occur in the roll contact arc, giving a neutral zone. For other hard metals, separate tests would be required to determine load economies.

The third paper in this session, which held especial interest for engineers, came from the Shibaura United Engineering Company, Ltd., Tokyo, Japan ; the authors being Messrs. Y. Yokote and S. Nomura. They spoke about their experimental study on a modern mill in " Rolling Aluminium Foil." This differs in important respects from the rolling of mild steel. A striking feature of foil rolling is that aluminium foil can be rolled very easily, in apparent contradiction of the theory of rolling. The experimental data on foil rolling were checked by calculations based on rolling theory, and it was found that their test data were in agreement with the results of the calculations for the first, second, and third passes. However, at the fourth and fifth passes, the actual roll pressures are far below the calculated values. This probably indicates that the aluminium being rolled is softened by heat generated at the roll bite.

The fourth and last of this interesting group of papers came from the Telegraph Construction and Maintenance Company, Ltd., Metals Division, Crawley, Sussex, where the authors, Messrs. H. H. Scholefield, J. E. Riley, E. C. Larkman and D. W. Collins, have studied the operating technique employed on the Sendzimir mill. Entitled " Some Experiences in Cold Rolling Thin Alloy Strip," their paper states that in the past the approach to thin strip rolling has been restricted by the limited demand for this material, but with increasing requirements full use is being, and will be, made of developments in mill design. One contributor to the discussion laid on the table examples of hard nickel alloys, such as the Nimonic alloys, which had been rolled in a mill that he described as a " pencil mill " in which the two small diameter work rolls were backed above and below by stout supporting rolls and held in place horizontally by two hydraulic rams, so that the material being rolled passed through the mill at 45 deg. to the horizontal.

The discussion of these metallurgical engineering matters continued in the afternoon, and another paper from the Research Department, Imperial Chemical Industries, Ltd., Metals Division, Birmingham, was presented by Mr. R. R. Arnold and Mr. R. J. Parker, " Resistance to Deformation of Aluminium and Some Aluminium Alloys," its dependence on temperature and rate of deformation. By means of experiments on a cam plastometer they have determined the resistance to compressive deformation of commercially pure aluminium, three non-heat-treatable aluminium alloys, and two heat-treatable aluminium alloys. The higher-strength alloys were susceptible to thermal softening effects.

Vacancies, Ageing and Precipitation

The presentation and discussion of the above-mentioned five papers of a metallurgical engineering character, in the Hoare Memorial Hall, drew a good audience and would have interested almost any engineer. It was clear, however, that physical metallurgists are equally interested in their studies of Vacancies, Ageing and Precipitation in metals because they simultaneously overcrowded the Convocation Hall where Session (B) was held. The five papers which they discussed, all of which have been printed in the journal, dealt with " The Effect of Specimen Size on the Quench-Ageing of an Aluminium — 3·8 per cent Copper Alloy," " Quench Ageing in Annealed Lead," " Clustered Vacancy Defects in Some Face-Centred Cubic Metals and Alloys," " Hardness Changes in Cold-Worked Aluminium Alloys During Short Ageing Treatments," and " The Effect of Structural Imperfections on the Age-Hardening of Aluminium-Zinc Alloys." All of these contributed to the available knowledge of metals ; more detailed comment on such papers is not appropriate to these pages.

Easing Foreign Language Problems for Engineers

Some day, if not every day, some senior engineer somewhere will wish to read a foreign technical paper, speak to a foreign engineer or visit a foreign country on business.

With this in mind the British Iron and Steel Federation has produced over the years four concise Iron and Steel Dictionaries, which are of real service in the export and import of many engineering products. Recently, a fifth, an English-Russian and Russian-English, dictionary was added. The dictionaries are slim little booklets 5in by 4in, intended to slip easily into the pocket, and they are freely available from the Information Office at Steel House, Tothill Street, London, S.W.1.

These little technical dictionaries may be referred to in the order of their new series as follows :

1. English–French and French-English : thirty-eight pages. July, 1957.

2. English-German and German-English : twenty-four pages. July, 1957.

3. Swedish-English and English-Swedish : twenty-two pages. May, 1954.

4. English-Spanish and Español-Inglés : eighty-two pages. March, 1957.

The last-named has a preface of references to the Iron and Steel Industry of Spain and to that in Latin America ; Peru, Venezuela, Colombia, Mexico, Argentina and Chile.

5. English-Russian and Russian-English : 110 pages. July, 1959.

This latest addition to this series of pocket dictionaries has especial reference to the continuous casting of steel. The first thirteen pages outline the history of that still novel process and illustrate typical installations.

Five pages give the Russian alphabet with English equivalent and imitated pronunciation, hints on using the vocabulary, numerals and weights and measures.

LETTERS AND LITERATURE

Letters to the Editor

We do not hold ourselves responsible for the opinions of our correspondents)

THE CHANNEL TUNNEL

SIR,—I am sure your readers will be glad to know that the question raised in the last paragraph of your leading article on the Channel Tunnel in your issue of April 29 was effectively answered by Sir Ivone Kirkpatrick when he spoke to a large and distinguished audience in the Grand Committee Room of the House of Commons on April 27.

Sir Ivone pointed out that the sole reason for inviting the two Governments concerned to underwrite the proposed Bond issue, by which 80 per cent of the cost of the Tunnel might be financed, was to make it legally possible for certain important institutions in other countries to take up these Bonds ; and that actually the bulk of the capital required for the Channel Tunnel would not be raised in Britain at all but would come from the investors of other countries.

Sir Ivone also emphasised what he called the political aspect of the proposal in bringing Great Britain closer to Europe in more senses than one. This is an aspect which your leader does not mention, but in present world conditions it is obviously of the first importance.

One can well understand the attractions of the Bridge from the engineering point of view ; but the simple fact is that it would cost twice as much as twin railway tunnels, and there is no prospect whatever of finance for a bridge being raised under private auspices.

As for "Hovercraft," it has yet to be explained how such vehicles could safely cross the Channel at 100 m.p.h. in hazy or foggy weather, bearing in mind the amount of shipping which uses the Channel every day.

The main point about the Tunnel is that once the Bridge is ruled out on grounds of cost, the Tunnel provides an unrivalled means for mass transport independent of surface weather conditions.

M. A. CAMERON

British Transport Commission,
222, Marylebone Road,
London, N.W.1,
April 29, 1960.

CHANNEL OR BRIDGE ?

SIR,—As I see it, the only valid objections to a channel bridge are its apparently greater cost and vulnerability. Vulnerability I'll concede—just. Cost, I won't. The cost of a bridge can be assessed beforehand to two significant figures. The cost of a tunnel is uncertain to even one significant figure, and may prove to be more than double the estimate.

J. R. EDISBURY

Chester,
April 27, 1960.

SUBTERRANEAN ATOMIC EXPLOSIONS

SIR,—One possible result of an underground atomic or nuclear explosion of great force might be the setting-off of an earthquake, where otherwise one might not occur. There has been one underground atomic explosion in the U.S.A. which did not cause a 'quake, but can this be guaranteed every time ? Even if the seismologists might say "most unlikely," considering the believed great depths of origin of most earthquakes, this perhaps would not guarantee a touch-off on one occasion of earth-crust instability, and the country that had the explosion would suffer the worst ; though, considering the present geological formations of the earth's crust, one can imagine that the effects might be wide. It would seem safest for humanity if all countries agreed to abstain from underground atomic or nuclear explosions by reason of possible risk of earthquake—even if remote.

A. J. FIELD

Wimborne,
April 19, 1960.

Book Reviews

Internal Stresses and Fatigue in Metals. Edited by GERALD M. RASSWEILER and WILLIAM L. GRUBE. D. Van Nostrand Company, Ltd., 358, Kensington High Street, London, W.14. Price 72s.

IN Detroit during September, 1958, there was held the second of a series of annual symposia sponsored by the Research Laboratories of General Motors and originated in 1957. No less than thirty-two contributors presented papers which, together with the discussion, are assembled in this book. Nine of the contributors came from various departments of the Research Laboratories of General Motors, two from Westinghouse and one from the Franklin Institute. No less than a dozen of the contributors came from departments in nine different U.S.A. universities. There were also four contributors from England, two from France and two from Germany. The purpose of this symposium was to consider and interrelate the phenomena of internal stresses and fatigue in metals, both from the solid state physicist's approach and from that of the engineer. All the papers presented at the symposium are included in this book, the arrangement of which follows the order in which they were presented.

Part 1 contains the four papers dealing with concepts and significance of internal stresses. Part 2 is composed of ten papers concerning crystal lattices, imperfections and stresses. Part 3 contains six papers about dislocations, internal stresses and fatigue. The last section of the book, Part 4, has four more papers on fatigue and related phenomena and includes a thoughtful summary of the conference by A. M. Freudenthal.

Finally there is a verbatim report of a lecture given by Professor C. S. Smith, following a banquet held on the first evening of the conference. This calls to mind hearing Kettering, who was then head of the General Motors Laboratories, make a similarly thought-provoking after-dinner oration in Detroit, when Smith, who studied metallurgy at Birmingham University, was still a student. Detroit has a long and good record in these original and philosophical dissertations.

There have been many conferences on fatigue and some on residual stresses but the singular feature of this one was the attempt to clarify some of the basic aspects of the two phenomena by considering them in the light of basic concepts of solid state physics or physical metallurgy, rather than in empirical engineering terms alone.

The many reproductions of electron micrographs, at what are from the viewpoint of classical metallography fantastic magnifications, $\times 500{,}000$ for example, are very informative and indeed fascinating. One of the contributed discussions gave a study of metal surfaces by means of the field ion microscope, a new way for the study of metal surfaces. This microscope has two quite special features ; its resolution is of the order of 2Å, so that individual molecules of a crystal structure can be rendered visible, and the field strength at the metal surface is of the order of 500MV per centimetre. For this field the electrostatic stress normal to the metal surface is 10^{11} dynes per square centimetre, and this outward force has the effect of keeping the metal surface clean and permits the study of the crystal while it is under stress.

For over half a century research workers have sought to find how fatigue cracks form and how they grow. Even now these questions remain substantially unanswered but more light is being shed on the basic physical processes involved in the fatigue of metals. Tests have been made in various pressures of air and other gases and it seems clear that almost every fatigue test is in a very real sense a corrosion fatigue test. The accepted classification distinguishing between body stresses (Continuum stresses) and textural stresses (Grain structure stresses) may need broadening, if the latter are the result of atomic incompatibility forces in the imperfect lattices and inter-lattice boundaries of the crystal as well as of the polycrystalline aggregate.

A theory is gradually developing of the continuum with distributed structural incompatibilities, and to this end the many divergent papers of this conference contribute usefully. Men from different mental disciplines jointly explored the common problem, and there can be no doubt that such inter-disciplinary activities are now more than ever important. Naturally they are of more interest to metallurgists than to engineers but all scientists have need of them.

Advanced Aero Engine Testing. Editors : A. W. MORLEY and JEAN FABRI, AGARDOgraph 37, published for and on behalf of AGARD by Pergamon Press, Ltd., 4 and 5, Fitzroy Square, London, W.1. Price 63s.

THE papers and discussions at a joint meeting of the Combustion and Propulsion Panel and the Wind Tunnel Panel of the Advisory Group for Aeronautical Research and

Development at the Eighth General Assembly (October, 1958) are here collected. The papers range from surveys of the available transonic and supersonic wind tunnels and altitude chambers in which air-breathing and rocket engines can be run to a detailed description of an airworthy Orenda engine with thermocouples on the turbine blading monitored through mercury sliprings in the exhaust cone and employed on the investigation of blade cooling by spraying the reheat fuel on to the first stage rotor blades. A surprising feature of the proceedings is the relative shortness of the discussions—many of the more substantial contributions are extensions rather than criticisms of the papers. However, both relevant and worthy of preservation is the comment by S. S. Penner (California Institute of Technology) on a paper entitled "Some Experiences in (or on) Combustion Scaling":

"It is rather remarkable that combustion systems, in which the initial conditions correspond to liquid sprays in a gaseous medium, can be correlated at all by using experimental and theoretical results which really apply to premixed gaseous reactants (e.g. stirred reactor data, nearly second-order chemical reaction rates, &c.). On the basis of results derived from recent experimental and theoretical studies concerned with diverging rocket chambers, we are inclined to take a rather cynical view with regard to the fundamental significance, but not with regard to the practical value, of semi-empirical correlations of experimental data. Thus we have obtained equally acceptable correlations for all of the measured parameters, and equally acceptable estimates for the 'fundamental' constants (e.g. activation energy, mean drop diameters, drop-size distributions, &c.), by using any of the following four radically different combustion models: (1) premixed gaseous reactants; (2) liquid fuel sprays burning in gaseous oxidiser; (3) liquid oxidiser sprays burning in gaseous fuel; and (4) liquid oxidiser sprays burning with liquid-fuel sprays. *The only requirement which seems to be really essential for the practical correlation of results is the use of an adequate number of variables with adjustable exponents.*" (Our italics.)

Actes du Colloque de Calcul Numérique, Périgueux 1957. Publications Scientifiques et Techniques du Ministère de l'Air, No. N.T.80. Paris: Magasin C.T.O., 2, Avenue de la Porte-d'Issy, Paris (15e). Price Fr.1800.

AT the Colloquium of Numerical Calculations held at Périgueux in 1957, eleven papers were presented in the field of Applied Mathematics, within the framework of the Annual Congress of the French Association for the Advancement of Science. These papers dealt with general aspects of numerical calculation, and comprised two papers by R. Cazenave, "Little-known Forms of Rotational and General Vector Fields," and "Generating Functions of Certain Point Transformations"; A. Martinot-Lagarde, "On the Distinction Between the Existence of a Derivative and an Analogous Property"; L. Derwidué, "Some Theorems relating to Hurwitz Determinants and others which occur in the Theory of Electric Networks and Servo-Mechanisms"; R. Guarné, "The Automatic Evaluation of Determinants by the Method of Reiteration"; R. Eybert, "Practical Summation of Series"; D. Riabouchinsky, "Use of the Numerical Calculus and Graphical Interpretation in order to demonstrate special points of the General Theory of Complex Variables"; S. Arend, "Some Aspects of the Problem of the Representation of Experimental Results"; H. Juricic, "On the Application of the Method of Least Squares to the Smoothing of Experimental Curves"; M. Kiveliovitch, "On Chronological Series"; and, finally, P. Vernotte, "The Regularising Machine."

Sixth Anglo-American Aeronautical Conference Proceedings. Edited by JOAN BRADBROOKE and V. A. LIBBY. Royal Aeronautical Society, 4, Hamilton Place, London, W.1. Price 126s.

THE sixth conference of the Royal Aeronautical Society and the Institute of the Aeronautical Sciences took place in Folkestone, Kent, from September 9–12, 1957. The proceedings now available in book form include not only the discussions but also written contributions. That the editors named on the title page have done more than merely transcribe the recordings is hinted by Leo Schapiro and Emerson La Bombard of the Douglas Aircraft Company, Inc., in their response to the discussion of their paper "Nine Years of Titanium Usage":

"They would take as complimentary the extensive discussions that had been presented, even though some were in the nature of taunts and some had been reduced from their orally presented form."

Powder Cutting and Flame Processing. By BÖRJE BRANDSTET. Höganäs-Billesholms Akt., Sweden (Powder Metallurgy, Ltd., Berk House, London, W.1). Free

THIS book has been compiled by the metallurgist and service engineer of Höganäs-Billesholms, the well-known Swedish manufacturers of iron and steel powders. It deals with the equipment and many applications of the powder cutting technique for deseaming, washing, gouging and lancing of materials which cannot be treated with the conventional oxyacetylene flame.

Books Received

Telegraphs in Victorian London. By John Durham. The Golden Head Press, Ltd., 26, Abbey Road, Cambridge. Price 15s.

Theodolite Practice. By J. A. Sandover. Cleaver-Hume Press, Ltd., 31, Wright's Lane, Kensington, London, W. 8. Price 16s.

The Instrument Manual. Third edition. United Trade Press, Ltd., 9, Gough Square, Fleet Street, London, E.C.4. Price 105s.

Rapid Statistical Calculations. By H. M. Quenouille. Charles Griffin and Co., Ltd., 42, Drury Lane, London, W.C.2. Price 10s.

F.B.I. Register of British Manufacturers, 1960. Thirty-second edition. Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Price 42s.

Nuclear Radiation Engineering: An Introduction. By F. W. Hutchinson. The Ronald Press Company, 15, East 26th Street, New York, 10, N.Y. Price 6 dollars.

Stufenlos Verstellbare Mechanische Getriebe. By F. W. Simonis. Springer-Verlag, Berlin-Wilmersdorf, Heidelberger Platz 3, Western Germany. Price DM.29.40.

The Shipping World Year Book and Who's Who, 1960. Edited by Donald Maxwell. The Shipping World, Ltd., Effingham House, 1, Arundel Street, London, W.C.2. Price 60s.

Automating the Manufacturing Process. By George F. Hawley. Reinhold Publishing Corporation, New York. Chapman and Hall, Ltd., 37, Essex Street, London, W.C.2. Price 40s.

Principles of Electricity and Magnetism. By Y. Rocard. Translated by G. F. Herrenden Harker. Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway, London, W.C.2. Price 70s.

Torsion Devices: A Survey of Their Design, Construction and Use. By P. J. Geary. British Scientific Instrument Research Association, "Sira," Southill, Elmstead Woods, Chislehurst, Kent. Price 21s.

OBITUARY

PROFESSOR MAX VON LAUE

To Professor Max von Laue, who died in Berlin on April 23 at the age of 80, was due one of the most revolutionary advances of physics in the present century. His suggestion, made in 1912, and quickly verified by Freidrich and Knipping, that X-rays are diffracted by crystals in a similar manner to that in which light is diffracted by gratings, not only provided proof of the wave nature of X-rays and means for measuring their wavelength, but also, conversely, made it possible by the use of X-rays of known wavelength to determine the structure of crystalline material, including such complicated three-dimensional structures as nucleic acids and proteins.

Born at Pfaffendorf near Coblenz in 1879, he studied theoretical physics at Göttingen, Munich and Berlin, and received his doctor's degree from Max Planck, the originator of the quantum theory. In 1908 he was appointed lecturer at Munich under Professor Sommerfeld, and it was here that he made the decisive contribution for which he was awarded the Nobel Prize in 1914.

Von Laue was appointed assistant professor of theoretical physics at Zurich University in 1912, and in 1914 became full professor at Frankfurt-on-Main. From 1919 onwards, he held the chair of physics at Berlin, and also directed the Institute of Theoretical Physics.

PROFESSOR C. J. BAKKER

PROFESSOR CORNELIS JAN BAKKER, who died in a flying accident near New York on April 23, had been Director-General of the European Organisation for Nuclear Research (C.E.R.N.) since 1955. Born in 1904, he studied physics under Zeeman in Amsterdam, and took his doctorate for research on the Zeeman effect in the spectra of inert gases. His spectroscopical work brought him for a time to the Imperial College, London, and on his return to the Netherlands he joined the research staff of Philips at Eindhoven. In nuclear physics, which at that time began to attract his interest, he collaborated with Professor Heyn on the design of a cyclotron for the Institute of Nuclear Physics, of which he became the director in 1946. In the same year also took place his appointment as professor of physics and director of the Zeeman Laboratory at Amsterdam. His service on several national and international committees and organisations included membership of the joint Dutch–Norwegian Committee which is responsible for the research reactor at Kjeller in Norway. In 1951, he was one of eight experts who drew up plans for the future European Organisation for Nuclear Research, and the following year was appointed director of the group responsible for the 600 MeV synchro-cyclotron. This machine, and the 25 GeV proton-synchrotron, which came into operation last year, constitute major milestones in the history of the C.E.R.N. organisation.

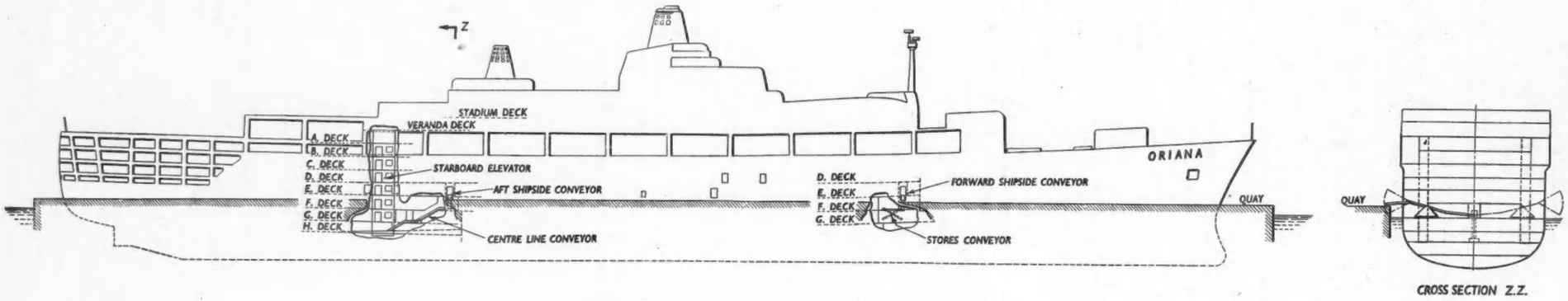
British Standards Institution

All British Standard Specifications can be obtained from the Sales Department of the Institution at 2, Park Street, London, W.1.

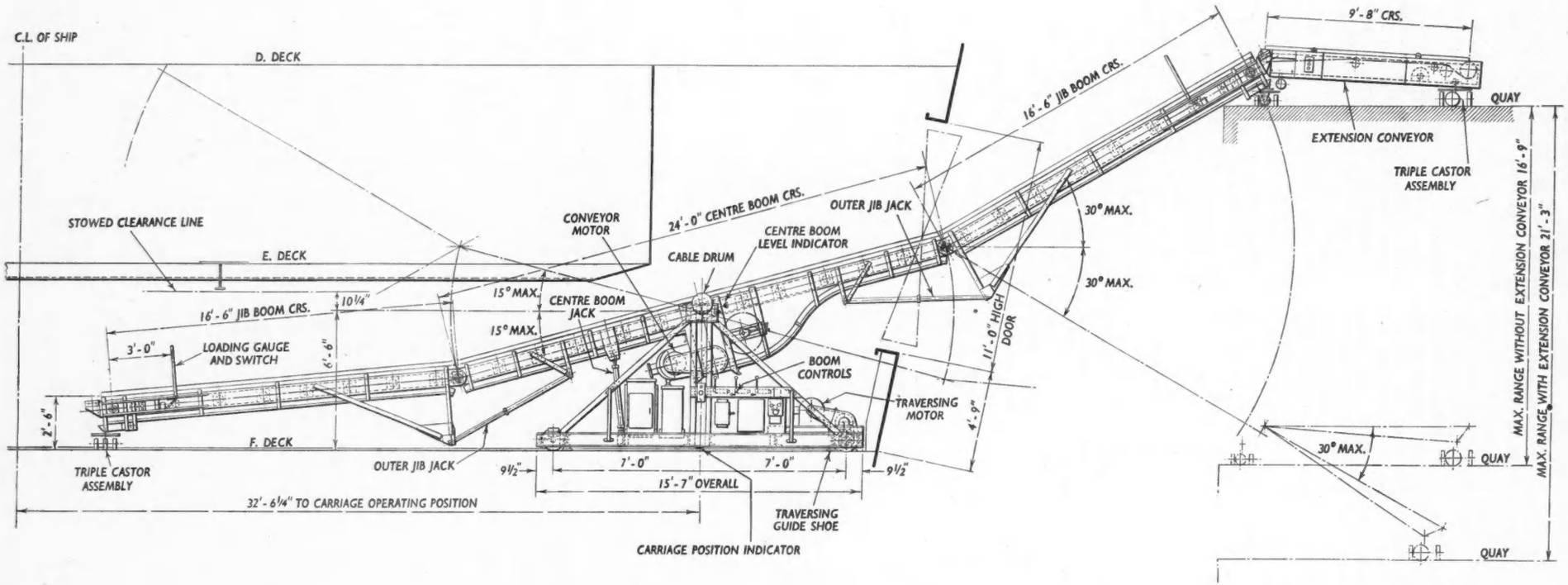
NON-SILVER-STAINING NATURAL RUBBER COMPOUNDS

No. 3106 : 1959. Price 3s. Five natural rubber vulcanizates, primarily intended to meet the requirements of Government departments, are specified in this new standard. These compounds, which are classified by their hardness, have been designed for applications where it is necessary to minimise tarnishing or corrosion of metal parts with which they may come into contact.

The specification includes test requirements for hardness, tensile strength, compression set, accelerated ageing and silver staining.



Disposition of baggage handling equipment on s.s. "Oriana"



General arrangement of shipside conveyor with extension fitted at end of outboard boom

Mechanised Baggage Handling Equipment for S.S. "Oriana"

A mechanical handling system has been specially developed and built for dealing with passengers' baggage on the new Orient liner S.S. "Oriana." This equipment combines the operations of receiving or delivering baggage between the quayside and the ship and distributing it between the decks on the ship itself. It is fully automatic in operation, and in addition to rendering the vessel independent of shore installations, considerably reduces the manpower required in handling baggage on the ship itself.

ONE of the problems associated with the quick turn-round of large passenger liners at ports is the time involved in the handling of passengers' baggage, which mostly has to be carried via the ship-to-quay gangways by stewards. At certain of the larger ports some time and effort are saved by using baggage conveyors between the quayside and ship; in other cases, baggage is handled in nets by cranes between the baggage holds and quayside. Whichever ship-to-shore handling system is used, however, a considerable amount of time and labour is still involved in the distribution and collection of baggage on board the ships themselves. A solution to this problem has now been provided on the new passenger liner "Oriana" built for the Orient Line by Vickers-Armstrongs (Shipbuilders), Ltd., and into the design of it there has been incorporated a comprehensive conveyor system for handling baggage between ship and shore and between the passenger decks on board.

This conveyor system was designed and built by Sovex, Ltd., of Erith, Kent, to the particular requirements of The Orient Steam Navigation Company, Ltd. Its general disposition in the "Oriana" can be seen in the diagram reproduced of the ship on the opposite page, and the construction of some of the main installations is shown in our other drawings. The handling equipment includes two shipside mobile slat conveyors situated on "F" deck, one forward and the other aft. Each conveyer assembly comprises a central section with a pivoted jib at each end and the reversible slat conveyer runs the full length. When the ship is in port the complete structure is traversed across to either the port or starboard side, as required, for the pivoted jib to project through a large door. In this position the outer jib foot rests on the quay for collection or discharge of baggage on the conveyor and the inner jib is lowered to deck level where its end is at a convenient height for handling the loads. The length of the conveyor is such that its inner end is about amidships when in the operating position. The aft shipside conveyor serves a fixed conveyor installed on the centreline of the ship and leading down to a baggage hall on "H" deck with an intermediate loading station in "G" deck. When the shipside conveyor is in operation the baggage is moved by hand along a short right-angled roller conveyor between its head and the centre line conveyor. This conveyor also serves baggage elevators, one on each side of the ship, which are used to transfer baggage between decks "B" to "H." The forward shipside conveyor, of similar design to that installed aft, delivers direct to trucks working between the conveyor and surrounding baggage storage rooms. This conveyor will also work in conjunction with a second short centreline slat conveyor used for the delivery and withdrawing of stores from "G" deck.

The general design of a mobile shipside conveyor is shown in the drawing on the opposite page, and the photograph (reproduced below) of one of the conveyors at the maker's works. As can be seen from the drawing, when the conveyor is positioned at the side of the ship with its pivoted jib end on the quay, luggage is taken along its full length to the centre of "F" deck. There is sufficient headroom in the doorway and a cut-out section of "E" deck to clear the loads, the maximum height of each piece of baggage being controlled by a "loading gauge" frame at the outer end of the jib.

The conveyor structure comprises three main pivotally-connected sections—a central boom 24ft long between centres, and two jibs each 16ft 6in long between centres. The boom is pivotally supported between the columns of a carriage having a rigid welded steel section framework and mounted on its platform is the whole of the driving and control gear of the equipment. This carriage runs on four rubber-tyred wheels, one pair of which is driven by a 2 h.p. motor to traverse the machine across the deck to its working position on either side of the ship. To maintain the alignment of the machine with the doors in the shipside a guide shoe fitted centrally at each end of the base frame extends down into a trough or groove formed by steel flats welded across the width of the deck.

The jibs pivoted on the main boom framework can be moved up and down by 36in-stroke hydraulic jacks. The centre boom is pivoted on the carriage columns and its angle set by extension or retraction of a 29in-stroke jack at one end. When the machine is in its operative position the central boom, which can be swung through an included angle of 30 deg., is aligned with the inner jib which is inclined with its inner end support castor on the deck at the ship centreline. The outer jib is lowered by its hydraulic jack to place its end support wheel on the quay, as shown in the drawing. The hydraulic circuit of the outer jib jack is then opened to leave the jib freely supported on its mushroom-shaped castor. The jib is then free to move up and down through an included angle of 60 deg., and backwards or forwards on its outer wheel in accordance with movements of the ship with the tide or current.

The conveyor has a 2ft 3in wide slat belt, the slats having replaceable "Neoprene" covers which are designed to provide resistance to baggage slipping down the slope when at the maximum angle of 30 deg. Its chain is driven by a 4 h.p. reversible motor at 70ft per minute, and a tensioned jockey sprocket in the drive automatically provides for the full range of jib settings. Power is supplied to the machine through a cable reeling drum

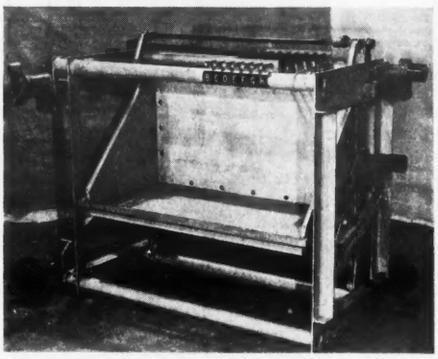
One of the shipside slat conveyors assembled at the maker's works

fitted to the upper part of the carriage at one side, the cable being accommodated above head height in a trough secured to the underside of "E" deck. As already mentioned a loading gauge frame is fitted at the end of each jib and when an oversize piece of baggage contacts this frame it is pushed sideways and operates a switch which stops the conveyor drive motor. The conveyor's heavy side-frame structure is designed to ensure that undue stresses will not be imposed when the outer end of a loaded jib has to move as the ship's position changes along the quayside with tidal variations.

When the machine is stowed it is placed amidships with its centre boom and jibs in a horizontal position and shackled to the underside of " E " deck.

As the effective jib length of the conveyor will be inherently insufficient for high tide working at the ports of Southampton and Sydney, where particularly high tides are encountered, a special conveyor extension unit has been provided to ensure that baggage is presented at a manual discharge level. This extension, carrying a two-ply grip surface belt, is 9ft 8in long between centres and is complete with its own motor, control being provided from the parent conveyor starter, via an extension cable and multi-pin plug and socket, the cable and plug being stowed in a compartment of the extension conveyor. It is mounted on twin 4in castors at the inner end and a special castor assembly at the outer end. The extension is hinged on to the end of the jib and when the ship is floating on a high tide with the main conveyor jib inclined at its steepest angle of 30 deg., it is supported between the hinged connection and its outer end castor assembly. This outer support has been specially designed to eliminate any tendency the extension might have to " drag " and unduly stress the jib structure when the ship moves during tidal changes.

The support consists of three heavy-duty rubber-tyred castors spaced evenly round a carrier plate which rotates freely on the spindle of a bracket member. This bracket is hinged at right angles at the centre of a main cross shaft rotatably mounted between the side members of the conveyor structure. The free movement in a horizontal plane, given to the castor carrier plate by the hinge-pin and cross shaft, provides a gimbal-like mounting. With this mounting, as the ship moves slowly fore and aft or up and down with the tide, the tendency the castors have to drag initially whilst turning is off-set by the universal movement imparted through their carrier plate.

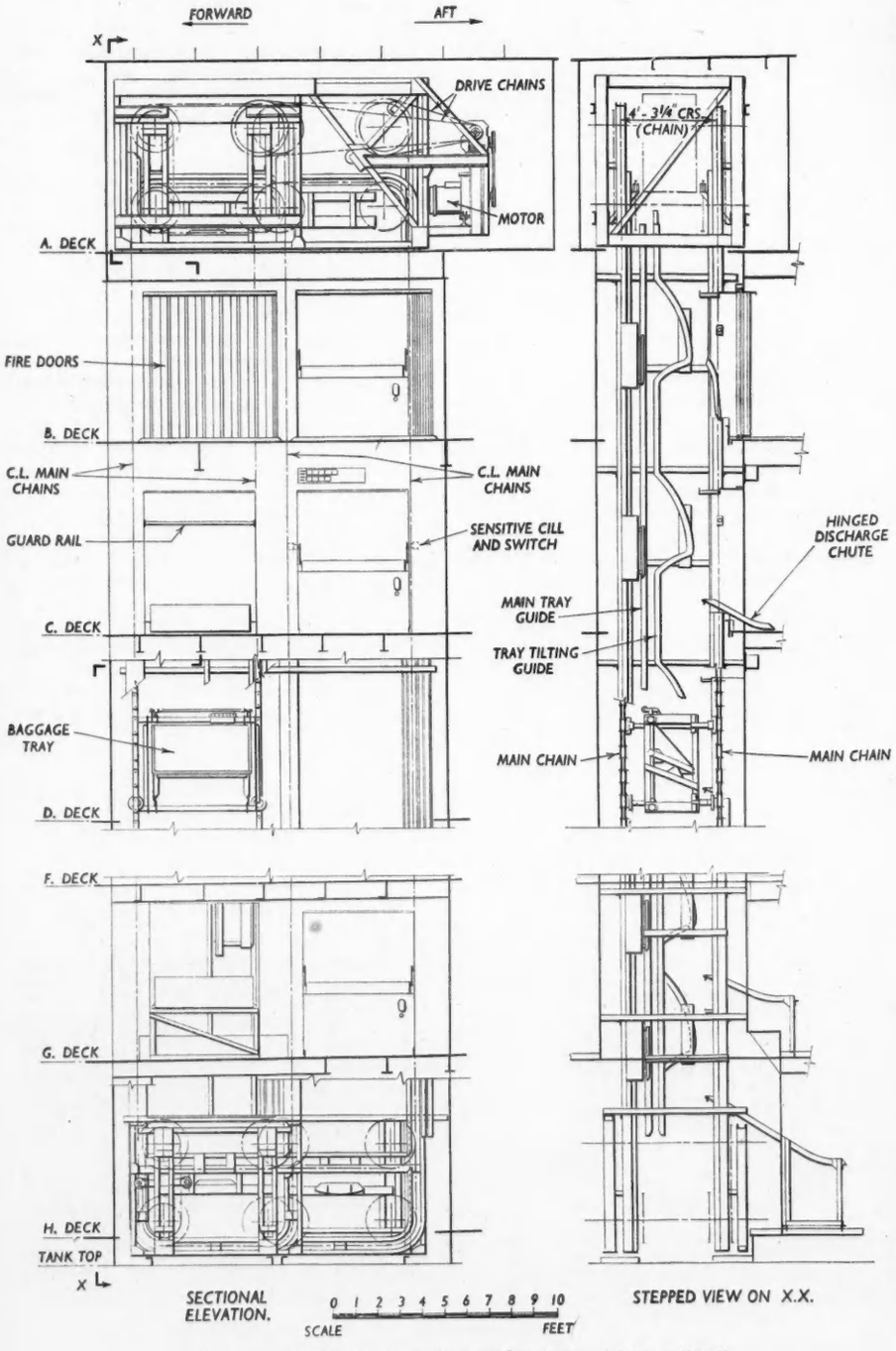


Elevator baggage tray fitted with selector buttons for automatic discharge at required deck

With this extension fitted on the jib, as the ship's level is lowered relatively to the quay with a falling tide, the inner end of the extension is supported through the jib structure end castor, its adjacent castors being maintained clear of the ground.

As previously mentioned, the aft conveyor handles baggage between the ship centreline conveyor, between " E," " F " and " G " decks, and elevators serving decks " A " to " G." The baggage is handled between the head of the shipside conveyor and the centreline conveyor on a short 90 deg. transfer roller conveyor along which the loads are guided by hand. The centreline slat conveyor is installed in trunking and is designed to take a maximum distributed load of 1600 lb. Its upper length runs down at an angle of 30 deg. from " F " to " G " deck, where it then levels out to provide an intermediate loading station, and the conveyor is then extended down at 30 deg. to " H " deck. To save time, this conveyor is loaded before the ship enters port and its control gear is arranged for repeated stopping and starting under fully loaded conditions. As this work is frequently carried out at night, the drive and controls are designed for silent operation. Photo-electric cells fitted at the conveyor trunk entrances are actuated to switch off the drive should there be loaded an oversize piece of baggage, likely to jam in the trunking.

When loading stores, the forward shipside conveyor works in conjunction with a slat conveyor which is situated amidships on " F " deck and can be pivoted from either end to extend down to the centre aisles of store rooms on " G " deck. This conveyor, with an overall length of just under 16ft, is of straightforward slat design, complete with reversible motor drive and control gear. When out of service, it is supported through brackets for its surface to register flush with " F " deck. A short distance in from each end, the underside of the frame is fitted with



Arrangement of baggage elevator serving decks " B " to " H "

sliding bolts which can be extended into brackets in the deck members.

Depending upon the end from which it is required to pivot down when preparing the conveyor for service, a pair of retracting " U " bolts are pushed up from below at the opposite end and hooked on to the tackle of a hand winch. The adjacent pivot bolts are withdrawn after the winch has taken up the load, leaving the conveyor free to be lowered until its adjustable pedestals rest on " G " deck. The baggage elevators on the port and starboard sides towards the stern of the ship and serving decks " B " to " H," are similar to the Sovex standard industrial selective elevator design. They are, however, of much heavier construction, to impart the higher degree of rigidity essential to a marine application where they are subjected to stresses not normally encountered in a land installation. The trays in an elevator are each designed to take a 2ft by 2ft by 4ft-long load weighing up to 100 lb, and each tray is fitted with a preselective self-discharging mechanism. The general design of one of the elevators can be seen in the drawing on page 782 and a typical tray is also illustrated. The number of trays fitted and the speed of the installation is designed to present three trays a minute to each of the loading and discharge counters on the decks served.

The elevator chain driving equipment is installed at the head of the main structure on " A " deck and comprises a 5 h.p. motor driving a reduction gearbox through vee belts. From this gearbox the drive is taken by chains to the sprocket wheels of the elevator chains. The trays are pivotally mounted in frames which are guided in vertical channels and coupled to the links of two 7in pitch chains at diagonally opposite corners. Pilot runners at each side of a tray frame run in a separate system of guide channels extending down the full length of the elevator framework. At each deck these guide channels are profiled to impart a tipping action to a tray according to the setting of its unloading mechanism. The pilot runners which impart the tray tipping movement are carried on a system of levers and the runners normally run freely round the profiles in the guides ; when this lever system is locked, its runners automatically impart the tipping action at a preselected deck.

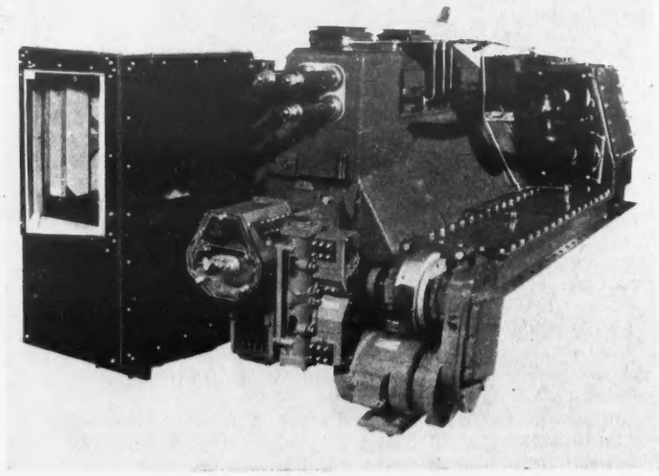
The preselective tray unloading mechanism is controlled through a series of selector rods mounted on each tray frame, each rod representing a deck and being marked accordingly. When a piece of baggage is loaded into a tray, the button of the selector rod of the required deck is pressed in. As the tray approaches the selected deck, a mushroom head at the inner end of the rod engages a solenoid operated mechanism which unlocks the tray guide runner system to impart the necessary tipping action.

British Railways A.C. Locomotives

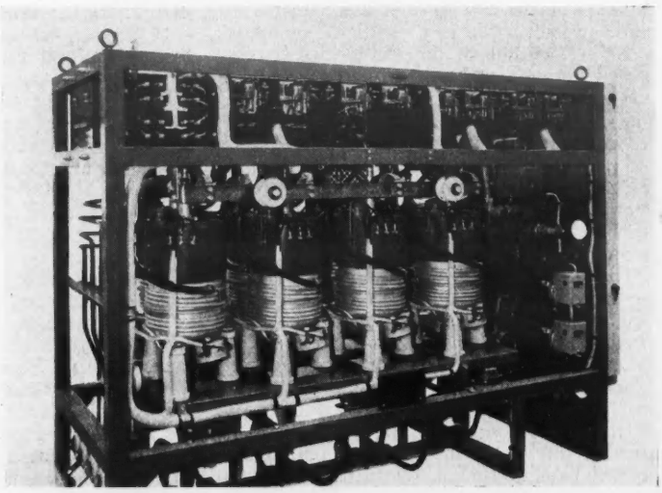
We illustrate the first locomotive in the second series of high-voltage, 50 c/s, a.c. locomotives for main-line service to be introduced on British Railways. This series consists of ten 3300 h.p. units for which the main contractor was The General Electric Company, Ltd., and embodies the first railway application in this country of control by high-voltage tap-changing. Maximum speed is 100 m.p.h.

WITH the appearance of new locomotives for the 25kV/6·25kV electrification schemes of British Railways, there is beginning to emerge a pattern of British practice in the field of industrial-frequency traction. Hitherto a.c. traction in general has been associated mainly with the Continent, and 50 c/s development in particular has been identified largely with the products of Continental manufacturers, both by reason of the results achieved and the steps taken to make these results and future projects well known abroad. With regard to locomotives for British Railways, some uniformity has been required in layout and manipulation of controls, but the various contracts allowed scope in mechanical and electrical design to the practices of individual manufacturers.

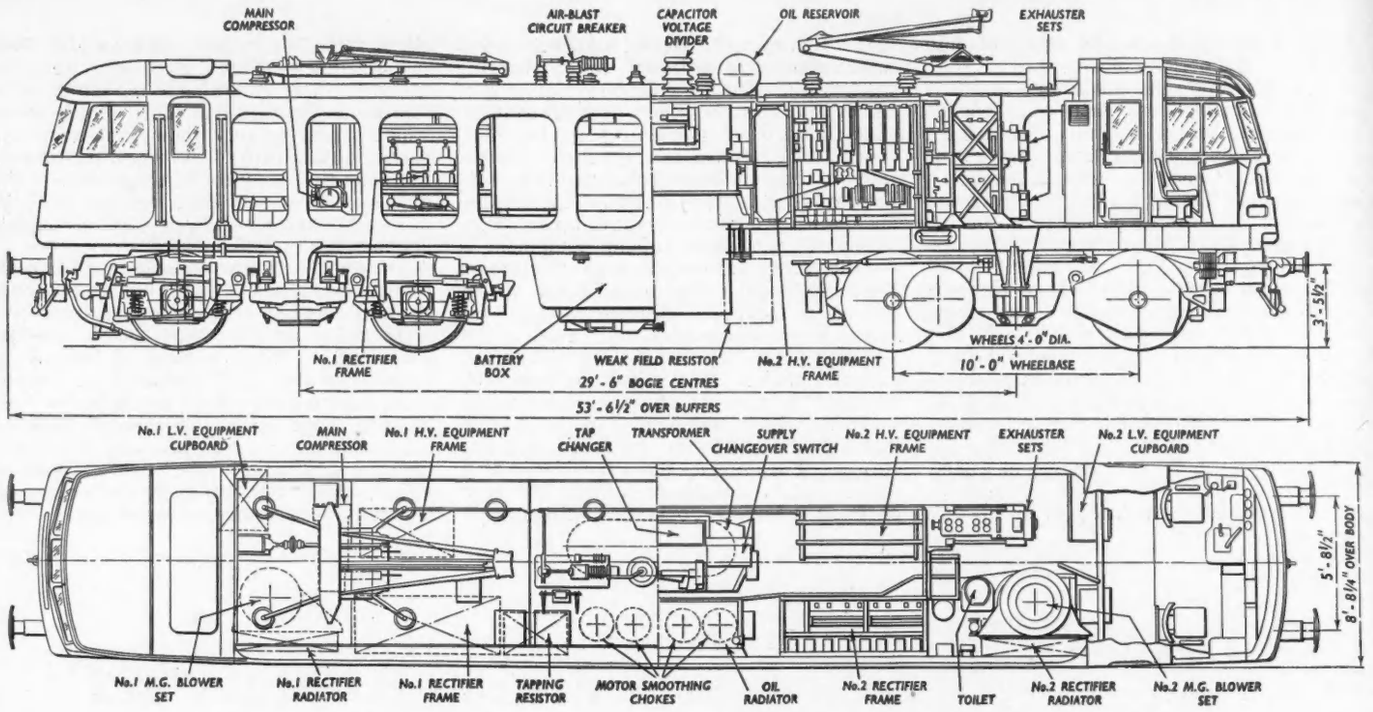
The locomotive shown in the heading illustration is the first of ten being supplied to the London Midland Region of British Railways by The General Electric Company, Ltd., which as main contractor has designed and manufactured the electrical equipment. Mechanical parts have been designed and built by the North British Locomotive Company, Ltd., as sub-contractor to the G.E.C. The overall design of the locomotives is to the requirements of the British Transport Commission, under the general direction of Mr. S. B. Warder and Mr. J. F. Harrison, Chief Electrical Engineer and Chief Mechanical Engineer respectively of



Motor-driven high-voltage tap-changer



Rectifier frame with single-anode excitron liquid-cooled units



British Railways type "A" B_0-B_0 3300 h.p., 25kV, 50 c/s a.c. electric locomotive

British Railways Central Staff. In meeting the specification of a maximum axle load of 20 tons using the B_0–B_0 wheel arrangement (applicable to all the a.c. locomotives ordered so far), the builders have in fact achieved in the first locomotive an overall weight of 76·5 tons. Continuous ratings are 3300 h.p. and 21,000 lb tractive effort at 54 m.p.h., and the maximum tractive effort is 50,000 lb.

The general layout of the equipment is shown above. Current is collected by one of two Stone-Faiveley pantographs and overall protection is given by a Brown-Boveri air-blast circuit breaker. Both these items were specification requirements (described in our April 24, 1959, issue).

The main transformer has a tapped auto-transformer regulating winding to which connection is made through the supply changeover switch. This is an off-load switch operating under the control of automatic voltage detection and selection equipment to select the appropriate input tapping to the regulating winding for line voltages of 25kV or 6·25kV.

The control tappings are selected by the motor-driven high-voltage tap-changer shown on page 783, the base of which forms the top of the transformer tank. A transition resistor fitted in a ventilated compartment at one side of the locomotive is connected between adjacent tappings for about one-tenth of a second during a tap-change. The resistor is centre-tapped, and in the second step of transition the connection to the primary of the fixed-ratio transformer feeding the power circuits is taken through one half of the resistor to this tap. On completion of the tap-change the resistor is out of circuit.

There are nineteen tappings on the regulating transformer, so that thirty-eight voltage steps are provided. On half of these, part of the transition resistor is in circuit as described above. These steps are not intended for continuous running. their purpose being to give a finely-graded build-up of the motor voltage. If progression is arrested on such a step the equipment notches back automatically to the next lower main tapping after thirty seconds. Air tapped from the main forced-ventilation circuit passes continuously over the transition resistor, but because of the difficulty of dissipating much heat in a small compartment, the time-limit system described has been preferred to rating the resistor continuously. After the thirty-eight voltage steps, two steps of field-weakening are provided by diverter resistors. A smoothing resistor is connected permanently across each motor field, and there are the usual smoothing chokes in the motor circuits.

The transformer output is taken from two secondary windings, each of which supplies a block of eight G.E.C. "Com-Pak" single-anode, liquid-cooled, mercury-arc rectifiers (page 783). This is an excitron rectifier in which improved methods of anchoring and cooling the cathode spot reduce the need for baffles and allow a small anode-to-cathode spacing with low arc drop. In this way one of the advantages which have recommended the ignitron rectifier for traction duty is achieved in an excitron, with its simpler excitation circuits. Pre-heating under thermostatic control is provided, and cuts in automatically if required when the locomotive is running, as may occur during long periods of coasting in cold weather.

The rectifiers are arranged so that each pair of traction motors is fed in bridge by four rectifiers from each secondary. The connections are such that the motors operate in series pairs under normal conditions, but are effectively in parallel under wheel-slip conditions by the transfer of current through an equalising connection between the mid-points of the motor circuits. Return current to the track is taken through earth brushes running on the outer ends of the road wheel axles.

The four traction motors are six-pole series-wound force-ventilated machines provided with compensating windings. Class H insulation is used throughout and the ratings are: continuous, 750 h.p., 725A, 850V, 1165 r.p.m.; one-hour, 890 h.p., 875A, 850V, 1100 r.p.m.

Driving position showing single control lever for automatic run-up/run-down or step-by-step notching

The motors are mounted through rubber pads in the bogie frame, and have fabricated frames to which are bolted the hubs of the Brown-Boveri spring drives. Support in the bogie frames is afforded by a three-point mounting formed by two brackets on the motor frame and an arm extending from the hub of the Brown-Boveri drive. This form of drive was illustrated in our June 19, 1959, issue.

In these locomotives the drive comprises a 5 deg. single-helical reduction gear with a ratio of 25 : 74, allowing a maximum service speed of 100 m.p.h. The large wheel is mounted on a quill shaft carried in

roller bearings in the drive hub. In the face of the gear a ring of spring-loaded pads engages with face dogs integral with a spider pressed on the road wheel hub. The drive is thus torsionally flexible and the axle is free to move vertically inside the quill shaft.

Drives for auxiliary services are provided by induction motors or by d.c. motors fed from the two motor-generator-blower sets. These sets embody a new approach to single-phase traction auxiliary drives in being driven by single-phase motors which are run-up to speed by motoring the generators from the battery, after which automatic changeover to a.c. running takes place. The main compressor, auxiliary compressor and the two exhauster drives are d.c., but the transformer oil and rectifier coolant pumps are driven by small induction motors.

Cooling air for all purposes is provided by the main blowers. It is drawn in through the rectifier coolant radiators and one stream then flows through a chamber in one side of the locomotive body containing the smoothing chokes and the transformer oil radiator (a small flow being tapped off for the transition resistor), while the remainder passes to the traction motors.

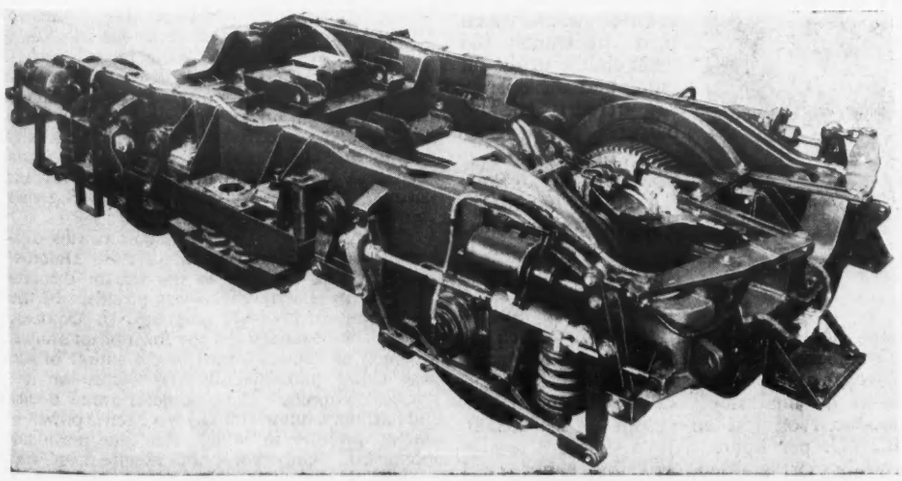
Driving controls and instruments in the cab (opposite) conform with the approved practice for new British Railways electric locomotives described in our December 4, 1959, issue. The driver can notch up step by step by a to-and-fro movement of the controller, or by placing the handle at "run up" or "run back" can allow the tap-changer to run continuously, arresting the action as necessary by returning the handle to "hold." In this locomotive a light brake application to arrest wheel spin can be made by push-button control from the driving desk, and, although sanding is provided, it is expected that this brake facility, combined with the electrical characteristics of the motor circuit, will make its use unnecessary.

The heading illustration shows the pillars through which the superstructure weight is transferred to the outer ends of the swing bolsters in the bogies. Below can be seen one of the seatings to receive the spherical pads in which the pillars terminate. Manganese-steel plates are welded to the seatings, and the plates in turn slide on manganese-steel plates bearing on the bolsters, the complete assembly being immersed in covered oil baths.

The vertical load on the bolster is transferred to the bogie via two double-coil springs at each end of the bolster. The springs seat on a bracket suspended from the bogie by spring links fitted with rubber-bonded hemispherical pads. In addition to the cushioning of vibration, these also assist in centralising the bogie after negotiating a curve. Movement of the bolster springs is controlled by hydraulic dampers anchored to the spring link brackets and to the top of the bolster. Lateral sway is checked by swing links and rubber dampers.

The bogie frame is supported on double-row roller-bearing axleboxes by two nests of coil springs at each end. The springs are rubber-cushioned at each end and attached by links to a compensating beam resting on the axlebox.

Traction and braking forces are transmitted from the bogie to the bolster by rubber-bushed traction links. A rubber-bonded steel bush in each bolster receives a steel king-pin which is attached to a cast steel centre welded to the main frame. Traction, braking and transverse forces are transmitted by these king-pins, of which the thrust point in the bolster is below axle level to minimise weight transfer.



Motor bogie with fully-springborne motors. The seating of a body support pillar is seen at the end of the swing bolster

Fuel Efficiency Exhibition

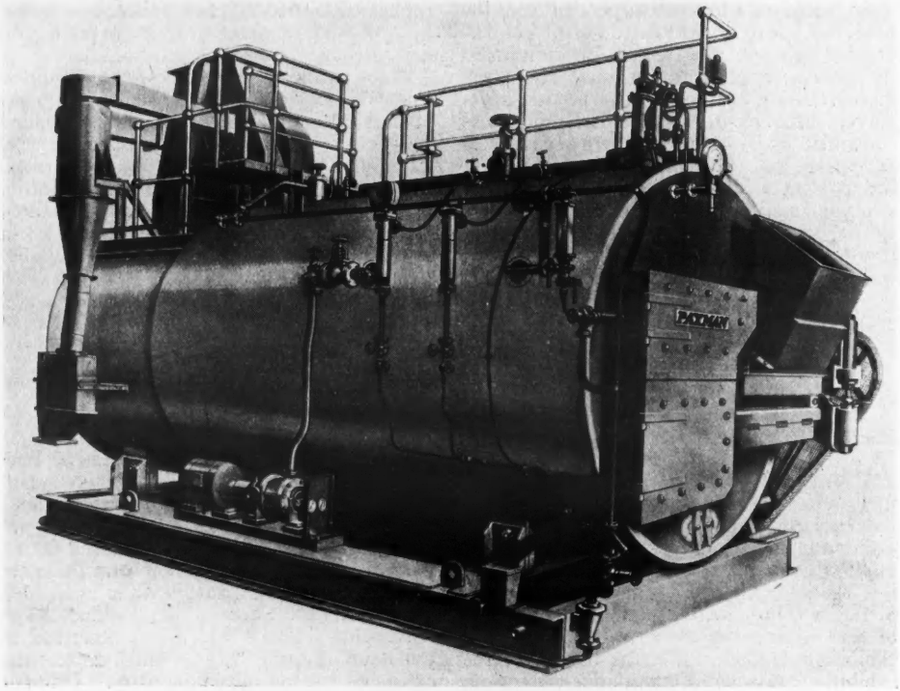
No. I

A WIDE and varied range of equipments designed for the efficient burning of fuel and utilisation of heat were on view at the Fuel Efficiency and Power for Industry Exhibition, which is installed in the Grand Hall, Olympia, London, and which opened on Wednesday, April 27, and closed to-day. Sir Dennis Proctor, the permanent secretary of the Ministry of Power, who opened the exhibition, remarked that the history of the exhibition was one of continuous expansion, there being about 150 exhibitors this year. As examples of improved fuel efficiency he noted that the quantity of coke to produce 1 ton of pig iron was reduced from 20 cwt to under 17 cwt from 1956 to 1959, while the amount of coal to produce a given quantity of electricity had fallen by 8 per cent during the years 1954–59. Other figures quoted by Sir Dennis recorded that over a three-year period of industry operating at a steady level, the annual rate of coal consumption dropped by 8,500,000 tons, of which 3,000,000 tons were due to increased use of oil fuel, leaving a saving of 5,500,000 tons largely due to improvement in fuel efficiency. These days of keen competition meant, he emphasised, competitive prices based on competitive costs, which depended upon maximum production efficiency. He called attention to the work of the National Industrial Fuel Efficiency Service and, before declaring the exhibition open, presented prizes to boiler operators who had gained their Certificates at the City and Guilds examinations.

Modern ways of automatically, smokelessly and efficiently burning coal are demonstrated by the National Coal Board, while "Six Years of Progress in Fuel Efficiency" is the theme of the National Industrial Fuel Efficiency Service stand where the ways in which many industries have achieved major improvements in heat-using processes are shown in detail. Various processes taking place in a heat-treatment shop form the main exhibit of the Gas Council, while Shell-Mex and B.P., Ltd., show a film entitled "The Advancing Flame," which was described in our issue of April 29, and which depicts the extensive use of oil in industry. Oil-fired equipment demonstrates the typical products of the members of the British Oil Burner Manufacturers' Association. The display of the British Iron and Steel Federation gives some indication of the industry's progress in the reduction of fuel and power consumption, and shows the major aspects of the clean air programme which has been carried out. On the stand of the Atomic Energy Authority the main theme is the progress made in the nuclear power programme and the research to reduce costs, together with illustrations showing the manufacture of elements and descriptions of new departures in reactor design.

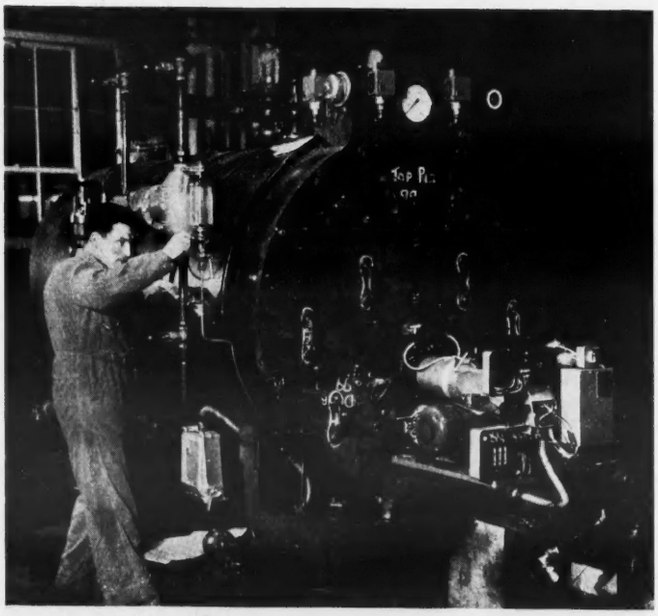
Davey, Paxman and Co., Ltd., has on view its "CoalPak" boiler, shown in our illustration, which is a welded packaged unit designed for ease of operation together with excellent accessibility. It is mechanically fired by a low ram coking stoker, which is automatically controlled over a large turn-down range, below which it operates on the on-off principle. There is a feed water level control and an overriding low water cut-out control. Also shown is a 195kVA alternator set powered by an air-cooled eight-cylinder "Vega" engine representing one of the range of diesel engines manufactured by the company. Typical products shown by Newton Chambers and Co., Ltd., included a Redfyre oil-fired corner tube steam boiler having a capacity of 3000 lb–5000 lb per hour at 250 lb per square inch, low circulation power and foundation costs, and low draught loss. This unit is suitable for heavy variation in load conditions and does not suffer from water hammer or thermal shocks. For central heating purposes there is a coke-fired unit suitable for large buildings, and the oil-fired "Centramake 50" which is thermostatically controlled and has electric ignition and a continuous rating of 50,000 B.Th.U. per hour.

Complete steam raising plant and ancillary equipment are exhibited in the form of a boiler house, the latter representing the constructional work carried out by John Thompson, Ltd. There are three boilers on view: a coal-fired super economic unit fitted with a Triumph travelling grate stoker; a "Multipac" oil-fired, wet back, three-pass package boiler of 2500 lb per hour evaporation built by John Thompson (Wilson



"CoalPak" mechanically stoker fired package boiler—Davey, Paxman and Co., Ltd.

Boilers), Ltd.; and an example of the latter company's smaller package boilers, the "Demipac," which have steaming capacities from 500 lb to 2000 lb per hour. The "Demipac," of which we reproduce a photograph, is of three-pass flue design embodying a wet back combustion chamber, and is of all-welded construction, X-rayed and stress relieved. A Nu-Way pressure jet air-blast burner unit is fitted, to operate on 950 seconds oil fuel, and is fully automatic with integral pumping and heating set. There is ignition control together with all safety devices to comply with the requirements for non-attended boilers.



"Demipac" boiler for the smaller industrial applications—John Thompson (Wilson Boilers), Ltd.

Besides having a fully packaged boiler and other examples of its products, Sunrod, Ltd., include a low-water safety device for steam boilers. This equipment automatically shuts off the fuel supply should the water level fall below a minimum permissible value, and consists of a water-cooled fusible plug container and an external switch. Cooling water, circulated by convection, enters the jacket of the plug container through a downcomer connected to the boiler at a point below the minimum permissible water level and returns to the boiler circuit through another pipe connected to the steam drum. Should the water level fall the flow of water in the downcomer ceases and the water in the jacket will evaporate, and the ensuing rise in temperature will melt the fusible plug and allow a spindle to move forward and release a counterweight. This will drop and open a switch, which then interrupts the main circuit to the oil pump and the operating circuit to the burner.

Edwin Danks and Co. (Oldbury), Ltd., exhibits a 10,000,000 B.Th.U. corner tube, hot-water boiler, and a "Symmetriflo" boiler, which has been designed for high-pressure hot-water heating, and in which is a number of concentrically arranged contra-flow gas and water passes. The boiler, which is in its final stages of development, has produced on test an output of 12,500,000 B.Th.U. per hour. An "Airspin" rotary cup burner is fitted, and this has an air turbine-driven rotary cup having a speed of 5000–6000 r.p.m., which assists atomisation and facilitates turn-down ratio. Also on the stand is a Danks-Simmon "Rotecon" rotating economiser, which is a combination of a water heater and draught intensifier, and can be located at any convenient point on the main flues. The company also shows its "Handimatic" control, for chain grate stokers, which has a geared drive to provide a wide variation of speed. The control is such that under all conditions of firing the fuel-air ratio is maintained, and under automatic control the grate speed and air supply is modulated to suit the variations in flow conditions. An associated company, Spencer-Bonecourt-Clarkson, Ltd., shows a 3000 lb per hour fully automatic oil-fired "Steambloc" packaged boiler, a Clarkson Bato/100 packaged thimble-tube boiler rated at 980 lb of steam per hour at 120 lb per square inch, and a new development in waste heat recovery. This is an evaporative cooling system which is demonstrated by an animated display.

(To be continued)

Thermal Efficiencies of C.E.G.B. Power Stations

A SAVING of £2,690,000 in fuel costs was made by the Central Electricity Generating Board during 1959, due to improved efficiency of the generating plant. The overall average thermal efficiency of the power stations operated by the Board was 26·36 per cent during the twelve months of 1959, compared with 25·99 per cent for the previous year. Almost one-third of the 90,828 million units supplied from these stations was provided by the twenty most efficient stations. These stations had an average efficiency of 30·67 per cent, their individual percentages being as tabulated below.

Station	Thermal efficiency, per cent
Blyth "A"	33·88
Agecroft "C"	32·63
Castle Donington	32·52
Ferrybridge "B"	32·18
Drakelow "B"	32·14
Willington "A"	31·96
Drakelow "A"	30·81
Marchwood	30·73
Rogerstone	30·44
Meaford "B"	30·41
South Denes	30·11
Tilbury	30·10
Stourport "B" (H.P.)	30·04
Stella South	29·95
Stourport "B" (L.P.)	29·78
Littlebrook "B"	29·76
Wakefield "B"	29·66
Portishead "B"	29·64
Stella North	29·36
Hams Hall "C"	29·26

I.C.E. Awards

THE Telford Gold Medal for 1959 was presented to Mr. H. Ridehalgh at the Institution of Civil Engineers on Tuesday, April 26, for his paper, "Shoreham Harbour Development." Other awards of medals made by the Institution for 1959 are the James Watt Medal to Mr. R. E. Sadler, for his paper, "Development in Overhead Electrification of Railways as it affects the Civil Engineer," the Howard Gold Medal to Mr. R. H. Wood, for his paper, "The Stability of Tall Buildings," and the George Stephenson Medal to Colonel Sir Ralf Emerson, for his paper, "A Project for Extending the Nigerian Railway into Bornu Province."

The Institution of Civil Engineers has also announced the establishment of the "Halcrow Bequest," provided for in the will of the late Sir William Halcrow, who was president of the Institution in 1946–47, and died in October, 1958. The bequest takes the form of an annual premium of £50 for award to the author of the best paper published by the Institution on specified subjects. These subjects are: docks and harbours, tunnels and hydro-electric power—among subjects in which the late president specialised. Only corporate members of the Institution are eligible for a premium. The subjects will be changed in a three-year cycle. Papers delivered over the previous three years on any one subject will be considered.

SHORTER REPORTS

Decimal Coinage and the Metric System*

A REPORT published by the Association of British Chambers of Commerce and the British Association for the Advancement of Science announces the result of two years' work. Each Association set up, quite independently of the other, a special committee to investigate the desirability, the practicability and the costs of introducing a decimal coinage and/or a metric system of weights and measures in this country. However, the two committees agreed from the beginning to carry out a joint investigation and have produced a unanimous report.

Questionnaires were sent out to individual organisations, trade associations, chambers of commerce, learned societies and professional institutions, Government departments, local authorities, nationalised industries and British Trade Commissioners overseas. Approximately 1000 replies were received and as some trade associations carried out investigations among their members and summarised the result, it is estimated that over 2000 organisations have submitted evidence towards compiling the report. In some cases this evidence has been supplemented by oral information and correspondence. The report is believed to be the most thorough and far-reaching investigation into the subject ever made in this country.

The cases for or against adopting either decimal coinage or the metric system or both are considered in detail, and the conclusions and recommendations drawn are based on the evidence presented by this cross section of industry and commerce. The committees' attitude has been objective. No assumptions were made that either a decimal coinage or a metric system of weights and measures was superior to the existing systems in this country. The intention was to present the facts, and to weigh the evidence carefully and impartially so that a dispassionate judgment could be made.

The committees have been concerned with the implications and consequences, both international and domestic, and the costs of a change over to the United Kingdom. Further, they have also considered, in the event of the adoption of a metric system appearing impracticable, the advantage of increased rationalisation or decimalisation of the present units of weights and measures.

The report is divided into four parts, with appendices.

Decimal Coinage

After an introduction describing how the inquiry was carried out, the first part deals with the problem of decimal coinage, outlining previous inquiries carried out in this country, the reasons for the present inquiry, and the implications of a change. The costs of changing over to a decimal system have been estimated, and these costs are compared with the long-term benefits which would flow from a change. The various methods of decimalising our coinage are then considered in detail.

The main recommendation is that there is a strong case for adopting a decimal coinage in this country. The committees recommend that the Government should take an early decision, since the longer the delay, the greater will be the transitional costs if the change is eventually made. The preparatory period might be three to five years, with about two years for the actual transition. Before taking such a decision the Government must, of course, sound public opinion, and must also decide on the most suitable system, bearing in mind that there is an overwhelming wish to maintain the pound as the main unit. If the pound need not be retained, a system based on a 10s. unit should be seriously considered.

* *Decimal Coinage and the Metric System, Should Britain, Change?* Butterworth's Publications, Ltd., 88, Kingsway, London, W.C.2. Price 7s. 6d.

Metric System of Weights and Measures

The second part of the inquiry deals, in similar fashion, with the metric system, outlining previous inquiries and the present position and trends within the U.K., Commonwealth and U.S.A. in metric usage. The international aspects are discussed, as is the problem of international standardisation and the difficulties which would be experienced by some sections of British industry. The cost factors of transition are also discussed. The predominance of engineering production in non-metric units and the international usage of non-metric units in certain spheres is also mentioned. There is, however, a general feeling that the metric system will in course of time become more widely used in the U.K. and the rest of the world. The committees therefore recommend that the Government should keep watch on the world situation and institute regular two-yearly reviews in consultation with industry and commerce and in conjunction with corresponding bodies in the Commonwealth and U.S.A. with the object of studying world trends towards metric usage and thereby deciding on any appropriate action in the future.

The committees are unable to recommend compulsory change over to the metric system in the immediate future because the benefits appear to be small and outweighed by the high transitional costs, particularly in engineering. However, practice in the use of the metric system and decimal thinking should, it is felt, be encouraged, to enable the U.K. to keep abreast of the world trend.

Improving the Imperial System

The committees then suggest some of the improvements which might be made to the existing system of weights and measures.

The committees recommend that all Government departments and nationalised industries "should examine how far it would be practicable to eliminate intermediate units of weight between the ton and the pound" and that apothecaries, troy and pennyweight systems "be removed from school curricula." Official abolition of the rod, pole, or perch, and its corresponding square measure, is recommended; so is increased use of the decimalised inch.

But the conclusion is reached that by decimalisation of existing units "there is no likelihood of reaching a comprehensive or coherent system."

Educational Aspects

The final section of the report discusses some of the educational aspects of a change in the system of coinage and weights and measures. The savings that could be made in education are estimated, and it is recommended that in any event much greater emphasis should be placed on the teaching of decimals in schools.

Electrical Research Association

THE thirty-ninth annual report of the Electrical Research Association was presented at the annual general meeting in London on May 4. In his statement the chairman of the council, Mr. O. W. Humphreys, outlined the progress of the Association in 1959. Referring to the proposed reorganisation of the sectional and research committees he explained that, whilst the broad outlines of the E.R.A. researches changed little from year to year, detailed changes were continually taking place, and it was necessary to ensure that they corresponded faithfully to the changing needs of industry. Accordingly it was proposed that, in place of the existing twenty sectional committees, there should be a much smaller number of divisional committees manned by high-level members who would not only know the basic general research needs of the electrical industry but would also be in a position to ensure the provision of funds to support these researches. It was planned to have the new scheme for divisional committees and research committees in full operation by the beginning of 1961. Mr. Humphreys emphasised that the broad objectives of this reorganisation were to ensure greater fluidity in the programme, to speed up the disclosure of results to members and to ensure that the greatest effort could readily be switched to the point where it was most needed. Other matters raised by Mr. Humphreys included liaison between members at home and overseas; progress in the building of the new creep laboratories; and the transfer of office staff from Thorncroft Manor to Cleeve Road.

The new office block will be contiguous with the creep laboratory which is now nearing completion at Cleeve Road. The creep laboratory is expected to be ready for use by the middle of this year and the office block before the end of the year. With the help of a capital grant from the D.S.I.R. it has proved possible to increase the space available for creep machines by about 50 per cent.

Another interesting addition made during the year is that of two small identical brick buildings, similarly oriented, remote from other buildings and equipped with a control hut to enable comparative tests on various methods of space heating to be carried out on behalf of the Electricity Council.

The Association gained thirty-two new members during the year but because of losses resulting from amalgamations and other causes the total membership fell by twenty. Now there are 224 ordinary members (of whom 206 are manufacturers, and eighteen are electricity supply authorities), seventy-four associate members, thirty-six overseas members and twenty-four associates. As part of a special effort to increase overseas membership the overseas liaison officer, Mr. E. W. Golding, made a tour of Commonwealth countries in Africa.

The income of the E.R.A. increased by about 6 per cent to £485,579 while the expenditure rose by 8 per cent to £498,914. There was an increase of £35,992 in the value of sponsored research carried out during the year. Taking this as evidence that industry is more willing to subscribe to special researches rather than to the general fund, the E.R.A. council looks forward to the time when a considerable income will be from such special support: outstanding examples of researches so supported in the past have been on switchgear, flameproof apparatus and the creep properties of steel.

Details of the Association's research achievements during the year are given in a separate section of the report. Some of these researches are briefly mentioned below.

Progress in the understanding of oxidation of transformer oil has been made by the discovery that one of the three main fractions of the oil (produced by liquid-phase chromatography) is more easily oxidised than the others and, in fact, acts as a catalyst in the oxidation of the other fractions.

Work is at present in hand to find possible uses for materials of the barium-bismuth-strontium titanate system, which have very high permittivities but are not ferro-electric. Materials in the Na-Nb-Sr-Bi-Ti system are also being studied in the belief that they may have similar properties. An automatic tracking comparator for comparing surface degradation in insulation material has been developed by the E.R.A. (Report No. L/T388) and is commercially available through a member firm.

Significant progress is reported in the construction of sealed-off vacuum contactors and units made with molybdenum passive and nickel-tin-alloy active components have performed more than 10,000 operations at 186A, 415V, and 1000 operations at 480A, 415V with

SHORTER REPORTS *(Continued)*

only 0·001in wear on the operating surfaces.

E.R.A. equipment designed and developed for the measurement of circuit-breaker post-arc current has been successfully demonstrated at a proving station and has been inspected by the relevant study committee of C.I.G.R.E. (Conférence Internationale des Grands Réseaux Electriques).

Work on transformers has included the development of a simple test to measure the axial displacement that occurs between transformer windings during construction. This test is of practical importance because of the very large electromagnetic forces produced between coils as a result of any dimensional asymmetry.

E.R.A. research on wind power generation has made possible the design and construction of a 100kW generator, built by R. Smith (Horley), Ltd., which is now undergoing tests in the Isle of Man in parallel with the public supply network. This machine has extruded aluminium blades which are being subjected to strain-gauge measurements to assess their service performance. Results obtained from an installation at an E.R.A. test station near Inverness (where the wind-driven generator is the sole source of power for the Warden's house on the Nature Conservancy Reserve) show that a study of the local wind regime can yield a close estimate of the energy that can be generated. On this site the E.R.A. automatic load selector has provided a satisfactory and flexible means of enabling all the energy produced by the generator to be absorbed usefully in accordance with the immediate needs of the available electrical loads.

A new multi-purpose crop drier was built in the spring of 1959 on Lane End Farm, adjoining the E.R.A. Shinfield Research Station. Despite the shortage of grass in the subsequent dry summer useful experience was gained. Laboratory tests have been carried out on the drying of grain at higher temperatures than those used in earlier work and the results have yielded practical design data for continuous-flow electric driers. A start was also made on a small-scale study of infra-red heating for continuous grain drying and this approach appears to be promising.

Work, in collaboration with Birmingham University, on the basic properties of the welding arc has led to the development of a new theory for the transfer of metal, based on the high velocity plasma jet (and its drag effect) at high current density. This theory is supported by measurements of particle flight showing accelerations of about 50 *g* for droplets of 1mm diameter and several hundred *g* for fragmentary particles.

Two-Speed Electric Motor with a Single Stator Winding

A NEW design of two-speed a.c. electric motor which offers economies in size and costs has been developed (on the basis of work done by Professor G. H. Rawcliffe* of Bristol University) in factories of Associated Electrical Industries, Ltd., 33, Grosvenor Square, London, W.1.

Where the duties of an induction motor require more than one speed, in a ratio other than 2 : 1, it has been the practice to use two stator windings; this arrangement is convenient but involves increasing the size and weight of the motor. Professor Rawcliffe's work, however, has shown that, with pole-amplitude modulation, a motor with a single winding can run at two speeds with a ratio less than 1·5 to 1 (e.g. with pole numbers such as 6/8, 8/10, 10/12, and so on), and a range of motors built to this design has been tested at Bristol University, in A.E.I. factories, and elsewhere.

In the A.E.I. factory at Rugby, a change-pole squirrel-cage motor rated at 800 h.p., 750 r.p.m., and 450 h.p., 600 r.p.m., designed to drive an induced-draught fan in a power station, was recently modified by the substitution of a single stator winding for its two independent windings. No other changes were made, except the provision of a new stator core to accommodate the winding. The accompanying illustration shows that the modified machine could be comfortably housed in a smaller frame, and, in fact, a smaller frame would be used for a motor of this rating designed in the first place with a single winding. This motor's performance has been found to be substantially the same as that of equivalent double-winding machines.

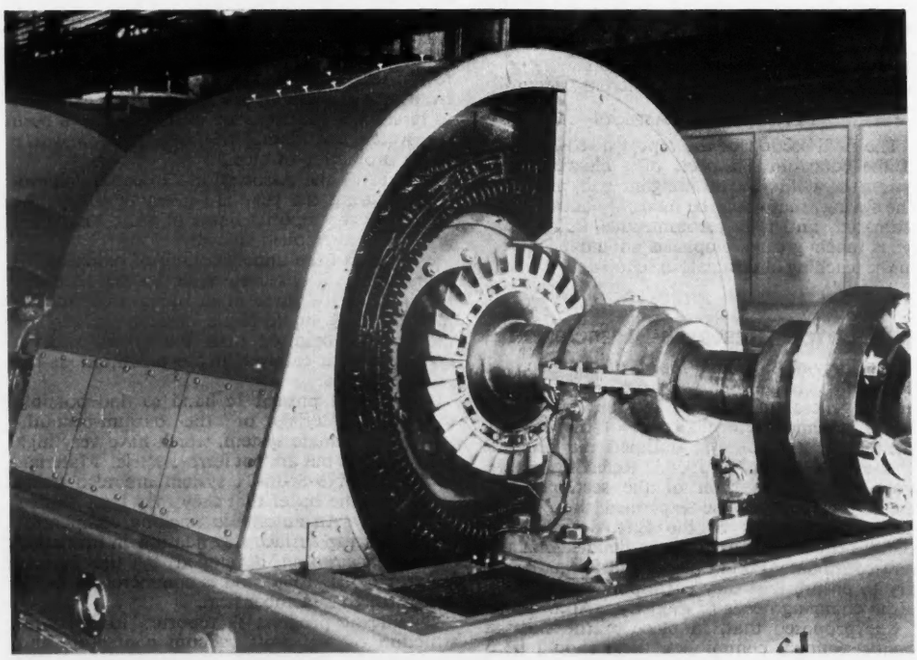
By using fractional-slot windings, A.E.I. Heavy Plant Division has evolved an alternative to the Rawcliffe system, in which 1·5 to 1 is no longer the upper limit of the speed ratios available. Although this method requires the use of more leads and more switching than pole-amplitude modulation, it gives the designer greater freedom in matching the characteristics of the motor to the load. It also involves extensive calculations, which at Rugby are done on a digital computer.

A.E.I. is now offering machines with the following pole numbers: 6/8, 8/10, 10/12, 12/14, 14/16, and upwards, where the difference in pole numbers is two. In these cases, there are six brought-out leads and a simple switching arrangement. Machines with multiples of the above ratios will also be supplied (e.g. 12/16, 16/20) with similar leads and switching.

With additional switching, machines with other speed ratios can be supplied. Where three or four speeds are required, change-pole machines with two stator windings will be available.

[Reply Card No. E7881]

* G. H. Rawcliffe, R. F. Burbidge, and W. Fong, "Induction-Motor Speed-Changing by Pole-Amplitude Modulation," *Proc. I.E.E.*, Part A, Vol. 105, page 411.



800 h.p., 750 r.p.m. and 450 h.p., 600 r.p.m. induction motor with one stator winding instead of two independent windings. It was designed as a conventional double-winding machine and the photograph shows how much space is saved by the use of the pole-modulated tapped winding

Pitch Fibre Pipes

IT was over a century ago that pitch impregnated pipes were used in Germany for gas supplies, and in our April 22 issue it was recalled that the introduction of pipes of such material was recorded in THE ENGINEER of April 20, 1860. However, it was not until the last decade in the last century that large-scale development took place in America, where the use of pitch fibre pipes has rapidly expanded. They were initially used for electrical conduits, but with the introduction of new manufacturing technique, namely vacuum impregnation, both quality and strength were improved and the pipes were increasingly employed for drainage and other services. It was not, however, until after the second world war that a start was made to develop the manufacture of pitch fibre products in this country. By 1956 four firms were interested in producing and marketing pitch fibre pipe, and a British Standard was agreed for drain and sewer pipes. A year later the Pitch Fibre Pipe Association was formed to ensure the highest standards of quality and to make known the characteristics of the products of the industry, together with their uses and installation techniques. To further this end the Association has now published a manual which contains information and data covering items such as properties, costs, laying, fittings and manufacture for the guidance of those using pitch fibre pipe. Copies of the manual can be obtained from The Pitch Fibre Pipe Association of Great Britain, 27, Chancery Lane, London, W.C.2.

Mechanical Packings for Valves

MECHANICAL packings are now available from Crane Packings, Ltd., Slough, as packaged sealing units for use in valves, and in control, compensating gear, and servomechanisms. These packings are designed to seal and be pressure tight on rotary screw and axially moving spindles up to at least 500 lb per square inch.

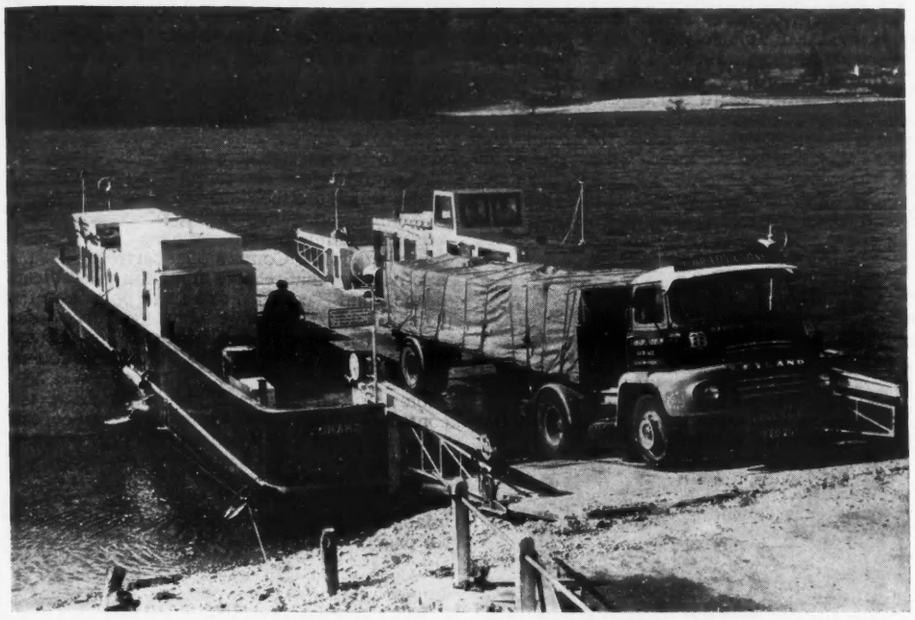
The packings are made in two forms which are equally applicable for the handling of relatively harmless liquids, such as water, as for handling corrosives or solvents.

The two versions are designed respectively for "press-in" fit or for flange mounting. The working temperature can be as high as 200 deg. Cent., depending upon the material code recommended, there being four material codes. The packings are available in a standard range of sizes from ¼in to 4in shaft diameter in ¼in steps.

[Reply Card No. E7883]

Conversion of Ferry to Diesel-Hydrostatic Propulsion

THE vehicle ferry "Drake" which entered service on Lake Windermere in July, 1954, has recently been returned to service following the removal of the original steam machinery, and its replacement by diesel power operating through a duplicate hydrostatic transmission system. Of flat-bottomed construction, the ferry, illustrated herewith, has a length of 95ft

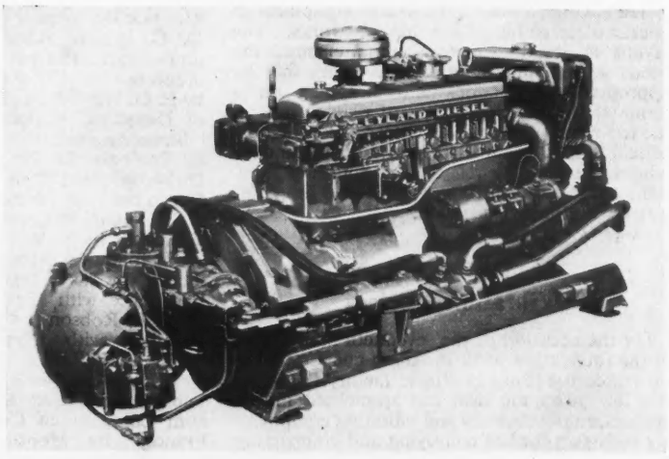


Vehicle ferry "Drake" after conversion

with ramps extended, a length between perpendiculars of 65ft, a moulded breadth of 30ft, and a moulded depth of 3ft 6in. The ramps, over which the vehicles move on and off the ferry, are raised and lowered by manual winching gear. Propulsion is by a mainshaft sited transversely in the vessel and having a large diameter pulley at port and starboard ends. These pulleys pick up and re-lay two parallel cables anchored to each shore to wind the ferry across the lake.

A coal-fired vertical crosstube boiler supplying steam to a two-cylinder single-acting steam engine formed the original power unit, and was coupled to the propulsion mainshaft. This particular design of machinery was selected in order to satisfy certain factors essential to the ferry service. They included a requirement that noise be reduced to a minimum, to preserve the amenities of the neighbourhood, and the ability to hold the ferry hard against the shore while vehicles were loaded and off-loaded. The steam machinery was silent, and it was a simple matter to open the engine throttle to apply maximum torque to the mainshaft and so exert a constant pull from ship to shore. Although satisfying technical requirements, operating costs, with the need to keep the boiler constantly under steam and the fire damped down overnight, proved to be extremely high. To provide a more economical service the Ferry Committee decided to investigate the possibilities of diesel machinery, and also decided to stipulate, in addition to existing requirements, that the machinery should be capable of applying full torque to the mainshaft for thirty minutes for shore holding purposes. Furthermore, two independent diesel engine units were to be provided, one to act as standby, so that the ferry service could be maintained during overhaul. With the steam installation it had been necessary to suspend ferry service during engine overhaul.

Leyland Motors, Ltd., designed a machinery arrangement to meet these requirements: this consisted of two Leyland-Ajax 5·75 litre marine diesels and a duplicate hydrostatic transmission system incorporating Dowty components. The Leyland-Ajax "Amazon" diesel engine is a six-cylinder, four-stroke, direct injection unit, having a bore and stroke of 3·96in by 4·75in, and a compression ratio of 16 to 1. For this installation the engine is rated at 40 b.h.p. at 1400 r.p.m. with a maximum of 90 b.h.p. at 2200 r.p.m. Fuel is supplied to the cylinders by a multi-element C.A.V. enclosed camshaft injection pump through four-hole injectors.



Engine and hydraulic pump assembly

Cooling is by a closed circuit fresh water system with heat exchanger. Each engine, as shown in our illustration, is directly coupled to a Dowty 240 variable displacement hydraulic pump of axial-piston tilting head pattern and a maximum swash angle of 35 deg. The two diesel engines and pumps are installed, side by side, on flexible mountings. Each pump unit is connected to a hydraulic motor which has identical parts but is permanently set to a maximum angle of 35 deg. Each motor drives a common worm reduction gearbox through a single dry plate clutch, which is coupled to the existing double helical pinion meshing with the mainshaft. Hydraulically each propulsion unit consists of a pump, motor and connecting pipes in the primary circuit; however, a low pressure circuit is also used to boost the suction side of the primary circuit. This secondary system includes a gear pump, driven from the free end of the engine crankshaft, a Micronic filter, a cooler and a small reservoir. Control of the machinery is by telemotor, there being two levers for each unit; one controls the engine injection pump and the other the swash angle of the hydraulic pump through a servo jack.

A 2kW variable speed 110V generator coupled to a hydraulic motor provides for the electrical demands of the ferry.

Preliminary tests have indicated that, on the basis of a fourteen-hour day throughout the year, the annual fuel bill will be approximately £300 compared with £2500 for the steam installation.

[Reply Card No. E7891]

Industrial Films

A NEW 16mm colour film produced by the photographic section of the Brown-Firth Research Laboratories shows the many technical processes involved in the manufacture of Firth Brown forged steel rolls and reviews some of the applications for which rolls are supplied. The manufacturing processes are recorded, including the forging of the ingots, annealing, machining, hardening and final grinding of the finished roll. Ultrasonic testing to establish freedom from defects and hardness are also illustrated. The care and maintenance necessary to obtain the best results from forged steel rolls in service is demonstrated, whilst examples of damage likely to result from accidents, or misuse, are dealt with and suggestions made as to the best methods for storing rolls. The film runs for twenty-seven minutes.

A film entitled "Tufnol in the Making" has been produced by the Ellison Film Unit for Tufnol, Ltd., Perry Bar, Birmingham, 22B, and was shown recently in London for the first time. The film illustrates in great detail the manufacture of "Tufnol" from the receipt of the paper, cotton and phenolic raw materials, through the impregnation, pressing and finishing processes. Great stress is laid on rigorous inspection at every stage of production. The film runs for twenty-four and a half minutes.

The English Steel Corporation, Ltd., in co-operation with William Doxford and Sons (Engineers), Ltd., have produced a 16mm documentary film, which runs for eighteen minutes, illustrating the manufacturing techniques employed in making Doxford built-up crankshafts and their use in the Doxford diesel engine. One of the most complicated parts of the crankshaft is the piece incorporating in a single forging a journal, two side webs and two side crank pins. The stages of manufacture of this part are followed from the casting of the ingot through the various stages of forging and heat treatment to rough machining. This production is shown in part at the works of English Steel Forge and Engineering Corporation, Ltd., in Sheffield, and in part at the works of the Darlington Forge, Ltd.

A new 16mm sound and colour film sponsored by Brockhouse Steel Structures, Ltd., West Bromwich, Staffs, was recently shown before an invited audience in London. The film briefly explains the architect's problems in producing buildings rapidly in face of a shrinking labour force in the building industry. It suggests a solution using non-traditional methods. Tuxford Secondary Modern School, Nottinghamshire, which incorporates the special prefabricated system of steel construction designed and produced by the company, is an example of building by the use of prefabricated sections. The methods of construction are described, from the levelling of the site and laying of concrete bases, to the cladding and decorating.

SHORTER REPORTS *(Continued)*

Gas Holder Supervision by Telephone

AN electronic equipment enabling recorded reports on conditions at a gas holder to be transmitted over public telephone lines has been brought into service by the Southern Gas Board. The installation, which operates between Newbury gas holder station and the Board's area control centre at Reading, has been developed jointly by the Distribution Engineer of the Southern Gas Board, Mr. F. Bell, and the manufacturer of the electronic equipment, Sound Diffusion (Auto-thermatic), Ltd., Portslade, Sussex, by whom the system was installed.

The equipment, known as "Datofonic," is a version of that operating between Princetown power station and the Bristol headquarters of the Western Electricity Board (see our December 18, 1959, issue) but the Reading–Newbury scheme makes provision only for monitoring. It was stated at a demonstration on April 26, however, that the addition of up to eighteen

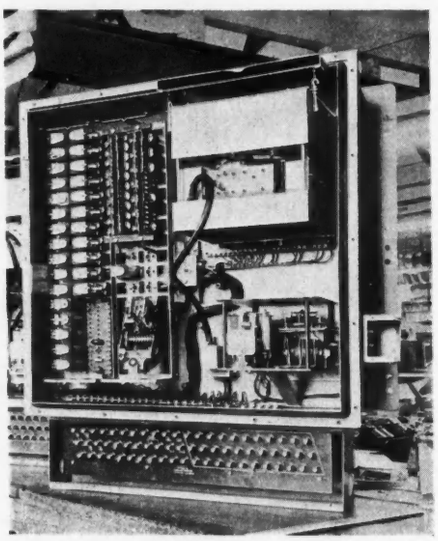
Record-player unit of gas holder monitoring system

controls by the transmission of voice-frequency pulses would add only two-sevenths to the cost of the equipment as now installed.

The need for the remote monitoring system arose from the Southern Gas Board's policy of concentrating manufacture at a small number of stations and converting former manufacturing stations into holder stations. The "Datofonic" system has been developed to meet the needs of the larger of these holding stations, where it is necessary to know stock in gas holders, grid main and local supply pressures, and to have alarms if the holder is on the point of overflowing or if its stock is dangerously low.

Communication over the 17 miles from Reading to Newbury is over normal telephone lines to Newbury manual exchange, where connection is made by the operator in the ordinary way to the line to the "Datofonic" equipment at the gas holder station. On being rung, the equipment reports on six main supervisory functions. If abnormal conditions occur, the equipment automatically engages the site telephone line and by means of a recording requests connection to Reading control room. Warning messages are prefixed by the word "Attention," and continue until the unit is stopped by transmitting a voice-frequency pulse from an oscillator at the Reading control room. A similar method is used to shut down the equipment after a normal monitoring broadcast has been requested. All the electronic apparatus is transistorised, and that at Newbury operates from dry batteries.

At the Newbury station tappings are taken to the "Datofonic" equipment from three recorders showing the performance of the grid main, local medium-pressure main and district supply pressure main. Gas holder level is obtained from a "Glycol" pressure pipeline fed from a tank attached to the holder, the pressure thus varying with the height of the holder, which is proportional to the quantity of gas in stock. When the apparatus is interrogated, the record shown in one of the accompanying illustrations begins to revolve (driven by a d.c. motor from the dry batteries providing the general supply to the equipment) and by means of high-frequency pips recorded at intervals steps a uniselector which scans the various conditions. According to the answering signals, only the appropriate portions of the record are transmitted to line. Forty-four announcements have been recorded, and are normally given in pairs, the actual value being the mean. However, where the actual figures are, for example, 3·5 and 4·5, the single figure "4" is transmitted. Pulses are also recorded on the record for engaging the line to Newbury exchange in alarm conditions. At the



Monitoring equipment showing standard layout of components

end of the record the pick-up is lifted and returned to its starting position by the track seen in the illustration.

We also illustrate "Datofonic" equipment in course of assembly at the maker's works. The layout is standard for all requirements, the needs of individual installations being met by appropriate connections and strapping on a terminal strip below the record playing unit at the top right-hand of the cabinet. The assembly of relays and the uniselector also form standard plug-in units. The relays have counting functions up to seven in binary code and are associated with the alarm system.

[Reply Card No. E7901]

Vibration Devices

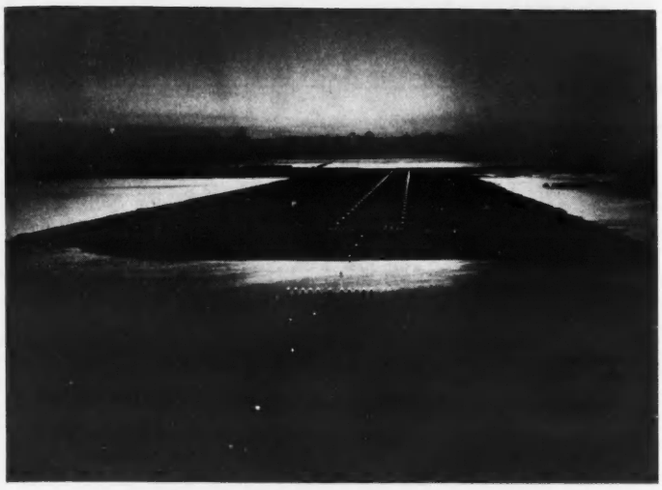
ON the occasion of the seventieth anniversary of the foundation of E. P. Allam and Co., Ltd., we visited the firm's Southend factory. For the last few years the firm has specialised in the production of vibrators and vibrating equipment for such purposes as conveying and compacting materials.

The firm has just designed its first vibrating rollers, in three forms employing the same 50 c/s electric eccentric exciter. (The firm considers that 50 c/s, besides allowing the generators to be used for powering other plant, is the most satisfactory frequency even for compacting very harsh and dry concrete mixes, although 200/240 c/s internal vibrators are offered.) The smallest roller is propelled by a pedestrian and carries a petrol-electric generator energising a single rotary vibrator. A pedestrian-controlled roller has a larger single-cylinder petrol engine and the alternator drives the rollers (through a reversing motor, two stages of sprocket chain and a friction drive employing pneumatic tyres) and two contra-rotating vibrators. These latter rollers, which impose a peak load equivalent to a 2½-ton roller, can also be supplied without engine-generator sets for use in tandem with a tractor : three were demonstrated, drawn by a Ransomes, Sims and Jefferies "MG" tractor in which the normal engine had been replaced by a Petter PC2 driving by vee-belts to a countershaft and thence by further belts to the transmission, exciter and alternator. The towed rollers can be replaced by vibrating plates which use the same eccentric vibrators.

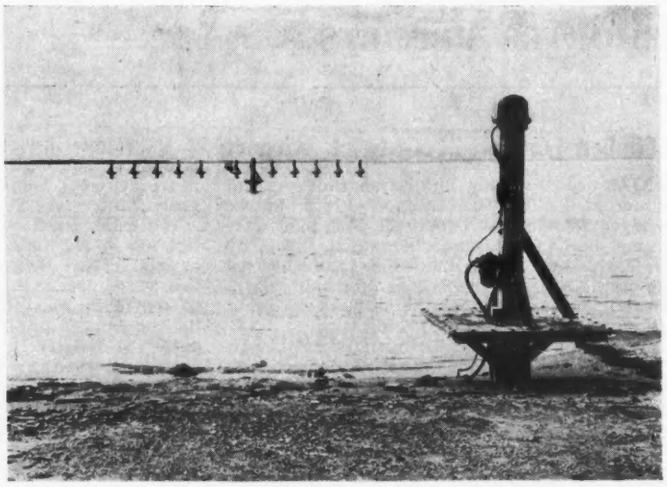
An interesting application of vibration that was demonstrated was to energise a "Roto Finish" tumbling drum. Conventional barrelling has the disadvantage that relative motion in the contents of the drum is confined to a small portion of the volume, and so much of the time the work spends in the barrel is wasted : it will be recalled that even Roto Finish, Ltd., have resorted to driving a workpiece linearly through the bed. Vibration can excite motion throughout the contents, but the optimum frequency will depend upon the size of the workpieces : the rotary exciter of the drum was therefore supplied from a variable-speed alternator. It will be recalled that the feasibility of this technique has been established in the United States of America—see page 747, April 29, 1960.

Aluminium in Railway Rolling Stock

A SYMPOSIUM on the Use of Aluminium in Railway Rolling Stock is to be held jointly by the Institution of Locomotive Engineers and the Aluminium Development Association on Friday, May 27, at the Institution of Mechanical Engineers, 1, Birdcage Walk, London, S.W.1. Mr. R. A. Smeddle, the President of the Institution, will open the Symposium and under his chairmanship five papers, under the general heading of "Design and Construction," will be introduced and discussed at the morning session. Mr. W. Brining, the President of the Aluminium Development Association, will be in the chair for the afternoon session, when a total of eight papers dealing with "Operation and Service Operation" will be introduced and discussed. The last five papers will be introduced by Mr. D. C. Brown, B.Sc. (Eng.), who will act as rapporteur. The papers to be discussed in the morning are : "The Properties of Aluminium," by E. G. West, B.Sc., Ph.D. ; "General Aspects of Design in Aluminium," by J. F. Thring ; "Stress Analysis of Integral Vehicle Structures," by Professor D. N. de G. Allen, M.A., and D. W. Windle ; "Impact Behaviour of Vehicle Structures," by Professor Sir Alfred Pugsley, D.Sc., and "Construction of Aluminium Vehicles," by S. White. The afternoon papers are as follows : "Experience of Subway Rolling Stock," by A. W. Manser ; "British Railways Experience with Light Alloy Diesel Railcars," by A. E. Robson ; "Assessment of Economics Obtained with Lightweight Rolling Stock," by F. L. Stafford ; "Experience in Canada," by R. A. Campbell, Transportation Director, The Roberval and Saquinay Railway, Aluminum Company of Canada ; "Experience in France," by Monsieur Dupre, Directeur de l'usine, Societé de Construction et de Reparation de Matériel Ferroviaire Rheims ; "Experience in East Africa," by J. Hudson, chief mechanical engineer, East African Railways and Harbours, Nairobi, Kenya ; "Experience in Germany," by Dr.-Ing. A. Mielich, Abteilungspräsident, Bundesbahn-Zentralment, Minden, West Germany ; and "Experience in the United States of America," by G. B. Hanser, manager, Railroad Section, Sales Development Division, Aluminum Company of America.



Western approach and runway lighting at Palisadoes



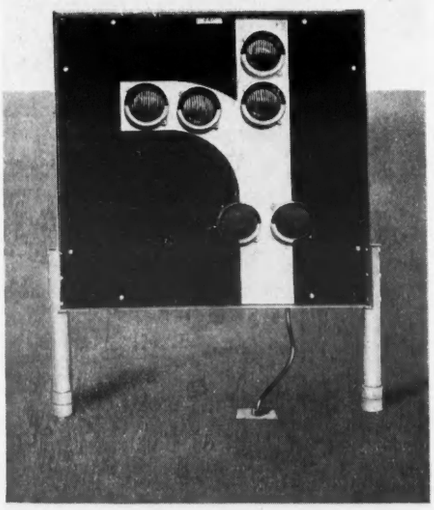
Centre-line and crossbar approach lights on piles sunk into sea bed

Palisadoes Airport Lighting, Jamaica

A NEW airport is being built in Jamaica on the Palisadoes peninsula, next to the old airport which is inadequate for aircraft such as the Boeing "707" and Douglas DC8. The new 7600ft runway and main taxiway are already in operation, and the terminal buildings and apron should be completed by 1961.

The runway and taxiway are built on a strip of reclaimed land projecting 8600ft into Kingston Harbour, and as can be seen in two of the accompanying illustrations the lights of the centre-line and crossbar approach system to the west of the airport are mounted on piles driven into the sea bed. The whole lighting system has been supplied by The General Electric Company, Ltd., Magnet House, Kingsway, London, W.C.2, and has been installed in collaboration with Barlow and Young, Ltd.

Runway lighting is by low-intensity elevated lights at 200ft intervals, with omni-directional distribution. The lights of the first and last thirds of the runway have 180 deg. amber filters for range indication. The runway lights are supplied with current by two separate interleaved series ring circuits, each fed by a substation at either end of the runway. If one circuit should fail, the lighting pattern will be maintained but with alternate lights only (i.e. at double spacing).



Taxi route indicator at Palisadoes Airport

Each light is fed at low voltage by a series isolating transformer, the primary windings of all transformers on a circuit being connected in series on the ring cable. The threshold lights, ten at each end of the runway, are of the same design as the runway lights, but are fitted with green filters, and have asymmetric refractors to concentrate the beams up and down the runway.

Approach lighting consists of red low-intensity omni-directional lights. The west approach lighting consists of a 1600ft centre-line of lights spaced 200ft apart with a 100ft wide crossbar 1000ft from the end of the runway. Being mounted above the water on piles, the fittings have cast iron metalwork to resist salt water corrosion. Isolating transformers are strapped to the piles and current is supplied from the west substation through cable anchored to the sea bed by concrete blocks. Site limitations prevented the provision of more than one crossbar, so that guidance is mainly lateral, but the threshold lights in conjunction with the crossbar also assist in gauging angle of descent.

Approach lighting at the east end is similar but with a shorter centre-line (1000ft) and a 100ft wide crossbar at the outer end. This lighting is supplied by the east substation. Brightness of all the runway and approach lighting can be controlled in three steps; maximum, 30 and 10 per cent.

Flush taxi lights with blue filters are installed along the edges of the taxiways and are on series circuits similar to those of the runway lighting system. To control the movement of aircraft using exit taxiway No. 3—which divides into two routes leading to the terminal area—an illuminated taxi route indicator has been installed in the form illustrated. The indicator consists of a black glass-fibre polyester resin panel about 3ft square with the junction pattern marked in white by an inlay of similar material. Two red lights in the lower arm hold the aircraft until the way is clear. The red lights then go off and two white lights come on in the arm indicating the appropriate route. The indicator lamps (6V, 36W) with their lenses are on hinged mountings to facilitate replacement. Each pair of lamps is fed by its own transformer and is controlled remotely by a selector switch in the control tower where a mimic diagram is provided for the remote control of all the airport lighting over telephone cables. Local control facilities are available at the substation cubicle switchboards.

Consultants for the runway, taxiways and traffic apron, and the airfield lighting system are Sir Alexander Gibb and Partners, while the new terminal buildings are the responsibility of Norman and Dawbarn.

[Reply Card No. E7911]

Railway Electrification Progress

POWER was switched on for the first time on April 25 to energise 7½ miles of overhead contact line between Broxbourne and Hertford (East) for the suburban electrification from Liverpool Street in the Eastern Region, British Railways. This section is part of the high-voltage a.c. electrification scheme covering the lines from Liverpool Street to Chingford, Enfield, Hertford (East) and Bishop's Stortford, which will be electrified partly at 6·25kV and partly at 25kV, 50 c/s. The Broxbourne–Hertford (East) section will operate at 25kV and is being energised in preparation for trial running due to begin on May 23. Trains for this electrification will be formed of multiple-unit rolling stock built by British Railways at York and equipped with rectifier traction equipments supplied by The General Electric Company, Ltd., incorporating the company's "Com-Pak" single-anode mercury-arc rectifiers described in our May 16, 1958, issue. The company has also supplied fluorescent lighting equipment operating through transistor-inverters from the 110V d.c. supply (since the a.c. voltage fluctuations would be inadmissible for lighting, and a battery standby is desirable), 1-gallon toilet water heaters, and electric carriage heaters for connection to a 265V a.c. supply derived from the motor coaches. An example of this rolling stock was included in a display arranged at Marylebone goods yard by the British Transport Commission on Wednesday and Thursday last week for members of the Institute of Transport attending the institute's congress in London. Other examples of new 25kV a.c. rolling stock exhibited were a driving trailer with A.E.I. equipment for the Glasgow suburban electrification and the first of the G.E.C. series of ten main-line locomotives (see page 783).

Surface Treatment of Aluminium

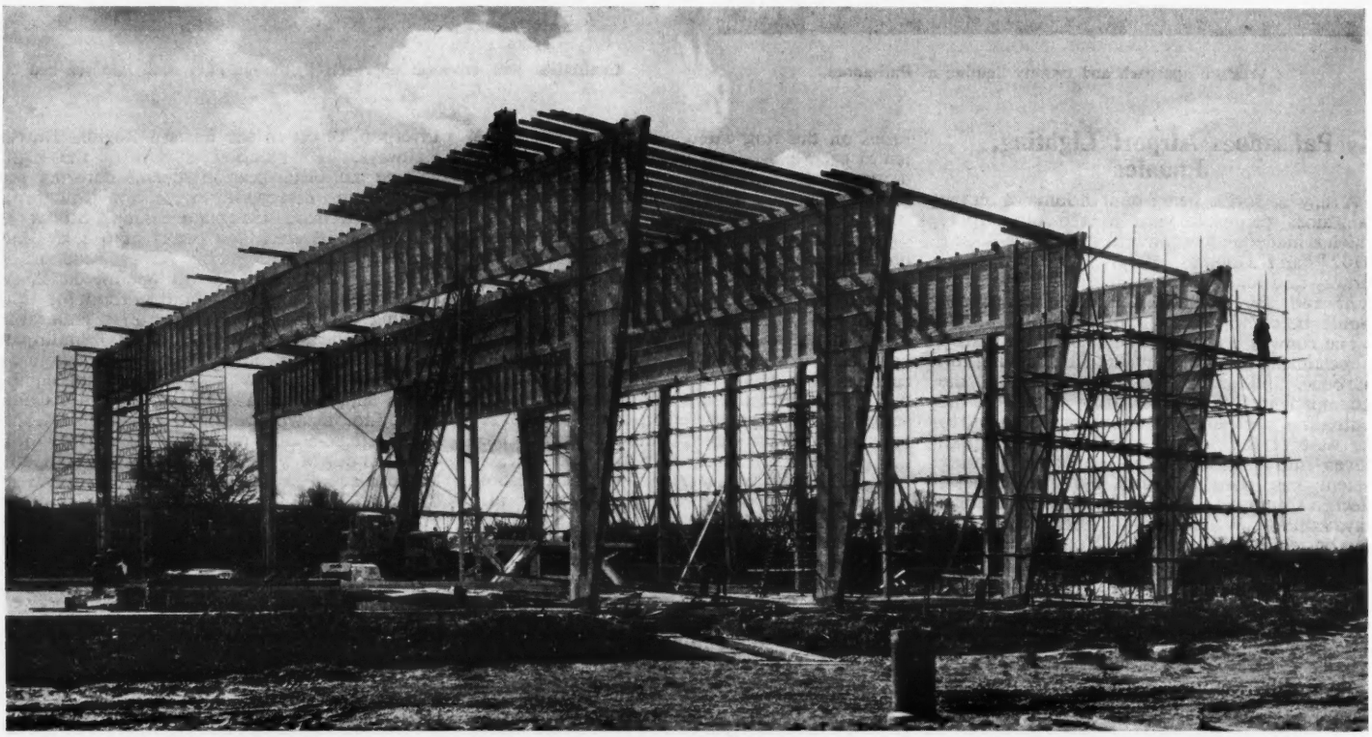
To meet industrial demands for treatments for the satin-etching of aluminium, The Walterisation Company, Ltd., has developed the Walterbryte Processes. These are Walterbryte H, and Walterbryte B, both of which are immersion treatments which etch the aluminium surface to give a bright satin appearance and should be followed by a protective treatment such as anodic oxidation, the Walterisation L process or one of the company's chemical chromate oxidation treatments. Walterbryte H has been designed as a heavy etching treatment to remove extrusion or draw marks, and the aluminium dissolved during the treatment will be precipitated as a sludge which will have to be removed by periodic desludging. The normal operating temperature is 50 deg. Cent., with an immersion time of five minutes. After processing, the work is rinsed in cold running water and immersed in a de-smutting solution. Walterbryte B removes less metal and is suitable for light etching; the solution, which gives only a little sludge formation, is operated at 30 deg. Cent., with an immersion time of five minutes. Afterwards the work is rinsed in running cold water and de-smutted.

SHORTER REPORTS *(Continued)*

Timber Hangar at Gatwick Airport

THE accompanying illustration shows recent progress in the construction of a timber hangar at Gatwick Airport. The hangar is being built for Overseas Aviation, Ltd., by J. Jarvis and Sons, Ltd., the sub-contractor responsible for the timber structural framework, including the design of the framework, being Beves and Co. (Structures), Ltd.

The hangar has a clear span of 150ft with clear headroom of 33ft, the entire roof and side cladding being supported on six frames spaced at 30ft centres, giving a 150ft depth. The hangar is probably the largest clear span timber building in Europe and is considered to be a major step forward in timber engineering.



Timber hangar at Gatwick Airport

The roof of the hangar has a 2in Stramit decking lined with asbestos paper and a felt covering externally. The side cladding consists of "Twin 12 Sandwich" construction by U.A.M. Company, laid horizontally. The doors are top-hung folding-sliding doors by Potter Rax, Ltd.

The structure is built according to a Swedish system—the H.B. system—which relies on nailing the timbers together. The nails are square, helically-twisted and galvanised, and their spacing and penetration are detailed in design with precision, according to the loads carried at the particular position concerned.

The frames are two-pinned portals, 171ft 8in long overall, and 10ft deep across the span of the hangar, and at the "lanes" of the portal, reducing to 2ft 9in at floor level. The frame has an "I"-section. The web consists of two or four layers of 1¼in board; the two layers are positioned diagonally, with opposing slopes, when they are nailed together, and stiffeners are nailed on. In the regions of the frame where the web has four layers, a horizontal layer of boards is nailed on each side. This extra layer is not needed structurally, but has been added to increase the fire resistance of the structure to a one-hour rating. The flanges are glued assemblies which are nailed on to the webs.

The frames are made in the firm's mill at Shoreham, and each one is brought to the site in six sections. These are joined together on the ground into three larger sections for erection.

A trussed frame—not shown in the illustration—is placed horizontally between the frames at knee level. By strutting between the frames, this bracing reduces the effective column length of the inner web of the portal leg, and also has the same effect on the laminated posts which carry the cladding at the sides of the hangar. For wind bracing, diagonal steel straps run between the four corners of the hangar and act in conjunction with stiffened purlins at the intersection points of the trusses and a wind beam in the Stramit membrane across the centre of the hangar.

The front gable frame carries the folding-sliding doors, which weigh approximately 22 tons. This frame has been notched at the centre point to accommodate a tail fin of up to 38ft above ground level. All the forces in the framework are transmitted to ground level through the "designed" system of nailing, and the splice connections have been carried out with nails and wood screws only. The framework of the hangar consists of approximately 80 standards of timber and 4 tons of nails.

[Reply Card No. E7921]

Annual Report of the St. Lawrence Seaway Authority

THE annual report of The St. Lawrence Seaway Authority for 1959 shows that in the first season of operation there was a net operating income of 5,261,000 dollars available for what is called "debt service," and so a payment of 5,000,000 dollars on account of interest was made by the Authority last month. The Authority's total income was 9,214,000 dollars and administrative, operating and maintenance expenses amounted to 3,953,000 dollars. Interest charge on loans from the Government of Canada was 7,994,000 dollars and the amount by which interest charges were not earned was, therefore, 2,733,000 dollars, divided as follows: Montreal to Lake Ontario section 1,457,000 dollars; Welland canal, 1,276,000 dollars. After making provision of 3,955,000 dollars for depreciation, the accounts showed a loss of 6,688,000 dollars for the period.

The final toll traffic figures are somewhat greater than those provisionally published and show that there was an increase of 75 per cent in the cargo carried between Montreal and Lake Ontario, as compared with 1958, the total being 20,590,000 tons. On the Welland canal, the total traffic was 27,530,000 tons, an increase of 29 per cent over the previous year. The Authority states that the major constructional works have been completed except for "clean-up" dredging of some 1,000,000 cubic yards, which will be done in 1960. Total capital expenditures to December 31, 1959, stood at 310,650,000 dollars, including interest during construction.

Launches and Trial Trips

BARPETA, cargo ship; built at Govan by Harland and Wolff, Ltd., for the British India Steam Navigation Company, Ltd.; length between perpendiculars 395ft, breadth moulded 59ft, depth moulded to upper deck 32ft 6in, deadweight 7500 tons, service speed 16 knots; four holds, five 3-ton electric cranes, four 10-ton derricks; four 350kW diesel-driven alternators; Harland and Wolff single-acting, two-stroke, opposed piston oil engine, six cylinders 620mm bore by 1870mm combined stroke, 5800 b.h.p. at 118 r.p.m. Launch, March 10.

ATHELPRINCESS, bulk sugar carrier; built by The Caledon Shipbuilding and Engineering Company, Ltd., for the Athel Line, Ltd.; length between perpendiculars 460ft, breadth 65ft, depth 39ft 6in, deadweight 11,700 tons, maximum draught 27ft 1in, service speed 13½ knots, sugar capacity 500,000 cubic feet, grain capacity 626,000 cubic feet; five centre-line cargo holds, four sets of wing tanks for water ballast, oil fuel and grain; two 240kW diesel-driven generators, one 75kW steam-driven generator, "Guardian" hull protection system, "Toxion" anti-fouling system; Hawthorn-Doxford opposed piston oil engine, five-cylinders, 5500 b.h.p. at 112 r.p.m. Trial, March 8.

INDUSTRIAL NEWS

Wages and Hours

The national committee of the Amalgamated Engineering Union is holding its annual conference at Blackpool. The subject of wages in the engineering and shipbuilding industries was debated by the committee on Wednesday of last week, when a resolution was carried calling for an increase of £1 a week in the wages of adult male workers. The resolution will be discussed next month at the conference of the Confederation of Shipbuilding and Engineering Unions, after which the Confederation will, no doubt, submit the claim to the employers' federations. It will be recalled that when agreement was reached, in January last, on reducing the statutory working week to forty-two hours, there was no further pressure on the union side about the claim for a wage increase which was submitted last year.

Last Friday, however, the A.E.U. national committee again discussed a forty-hour week and agreed that a claim for its introduction should be pursued. But it became evident during the debate that the wage claim should take priority this year, although it was emphasised that the forty-hour week remained one of the union's important objectives.

Steel Expansion Projects

Two further schemes for steel plant expansion have been announced this week. The first of them is at the East Moors works Cardiff, of Guest Keen Iron and Steel Company, Ltd., where it is proposed to spend £6,750,000 to raise production of both iron and steel from present levels to make 1,000,000 tons of ingots a year. At present, three out of four blast-furnaces are operated, yielding some 610,000 tons of iron annually, the fourth furnace being a standby. The plant will be altered to enable all four furnaces to be blown simultaneously as is current practice. This will give about 875,000 tons of iron and will enable the iron works to keep pace with the needs of the steel melting shop. In the melting shop itself, production will be increased to 1,000,000 ingot tons a year by the extensive use of oxygen in the open-hearth furnaces and the use of a larger ingot. Included in the development is a fume extraction plant, costing about £300,000, by which emission of smoke and dust will be controlled. In the mills, extra rolling stands will be installed to enable the production of billets to be increased both for use within the G.K.N. group and for sale outside the group. Ancillary services will be strengthened by the inclusion of a new mould assembly and ingot stripping shop.

The second project is that to be put in hand by English Steel Corporation, Ltd., at Tinsley Park, Sheffield. It is proposed to replace billet mills, installed at the River Don and Stevenson Road works more than forty years ago, with a modern installation comprising one 42in blooming mill and two 32in billet mills which will permit more economical production of a larger volume of alloy and special carbon steel billets. The capacity for billet production will be increased by 250,000 tons a year, some of which will be processed in other plants of the group. In addition, the bar rolling mills at River Don works are being replaced by new mills which will give an anticipated additional output of 60,000 tons a year. To provide the additional steel required, three 100-ton electric melting furnaces are being installed and, with this addition, the total melting capacity of the group for the production of alloy and special carbon steels will be approaching 1,000,000 tons a year. The estimated cost of the project is £26,000,000 and it is planned to be in full operation in 1963. The plant will be operated by English Steel Rolling Mills Corporation, Ltd., a wholly-owned subsidiary company. The proposals for a heavy forge at Tinsley Park which were approved in 1956 have been deferred.

Engineering Exports

The Board of Trade says that exports of United Kingdom products in the first quarter of this year were 10 per cent above the average level of 1959. Exports of engineering products were at a monthly rate £22,000,000 higher than a year ago, representing an increase of 19 per cent. Exports of non-electric machinery rose by 25 per cent during the quarter, representing an increase of £12,000,000 in the monthly rate of export. There was an increase in exports of agricultural and tracklaying tractors. Tractor exports in the quarter were at a rate 49 per cent higher than a year earlier, there being a sharp increase to the U.S.A. and Australia. An increase of 12 per cent in exports of internal combustion engines, industrial and marine, was widely spread, countries to which exports increased including India, Pakistan and Belgium. Exports of electrical machinery were 8 per cent higher than a year earlier, the increase being mainly attributed to a higher volume of exports to Australia, Canada, U.S.A. and Argentina.

Agricultural Engineers Association

At the annual meeting of the Agricultural Engineers Association, held in London last Friday, Mr. W. D. Akester, a director of Ransomes, Sims and Jefferies, Ltd., was elected president. The principal guest at a luncheon following the meeting was the Lord Mayor of London, Sir Edmund Stockdale, who emphasised that, to-day, British agricultural engineering had most of its commitments overseas. In this country, he said, one could see a high standard of farming and a high standard of the engineering skill associated with it. Countries such as Britain, the Lord Mayor added, had a duty to provide all the means within their power so that misery in many parts of the world, caused by lack of food, could be eased.

Capital Investment in Industry

In a " supply " debate in the House of Commons last week, Mr. John H. Osborn asked that consideration should be given to the encouragement of " well directed capital investment in industry, particularly investment in new plant and machinery to improve productivity." He emphasised the need to examine the quality of capital investment and to encourage technological research in industry so that processes designed to bring about this country's future prosperity could be developed and applied. The Government's main responsibility, Mr. Osborn urged, was to provide the right climate for investment and to leave the opportunities for private industry and public sector industry to exploit.

Speaking on behalf of the Government, the President of the Board of Trade, Mr. Maudling, pointed out that the call on the national resources must be limited to what those resources could produce. Last year, he said, there was an expansion of 10 or 11 per cent in total production, but that was because a great many resources which were previously idle were brought into use. But he did not think another expansion on the same scale could be expected this year. There was, of course, Mr. Maudling added, room for the very vigorous and healthy expansion which was taking place. The purpose of the Chancellor's recent budget, he remarked, was to ensure that expansion, although continuing strongly, should not outrun the resources available.

Tractor Factory at Basildon

Hitherto Fordson tractors have been manufactured exclusively at Dagenham, but Ford Motor Company, Ltd., has now decided to move tractor operations from Dagenham and concentrate them in a new factory to be built at Basildon in Essex. A 100-acre site is designated there for this purpose, close to the industrial areas on the northern fringe of the new town, and a start will shortly be made on the building of a completely new 1,000,000 square feet tractor factory at an estimated cost of £10,000,000. Staffing of the new factory will be met by those at present employed on tractor production at Dagenham. The fact that Basildon is only 20 miles from the Dagenham factory will make it possible for many to work at the new plant without moving their homes. This project is part of the £70,000,000 expansion plan, of which the first announcement, made in February, concerned Ford Motor Company's intention to locate major expansion of its car production on Merseyside. The company already has a general engineering factory at Basildon, which now employs 1100 people.

Shipbuilding Orders

According to information supplied by The Shipbuilding Conference, orders were placed with British yards in the first quarter of the year for fifty-three ships of 196,000 tons gross, compared with fifty-three ships of 55,000 tons gross ordered in the corresponding quarter of last year. The total intake of orders for the twelve months to the end of March, 1960, amounted to 198 ships of 460,000 tons gross, the corresponding figures to the end of March, 1959, being 158 ships of 511,000 tons gross. Including the latest contracts, the industry's order book at March 31 stood at 471 ships of 4,044,000 tons gross at an estimated value of £605 million, while at March 31, 1959, there were 592 ships of 5,103,000 tons gross on the order book. During the quarter five ships of 55,000 tons gross were cancelled, making a total for the twelve months of sixteen ships of 227,000 tons lost by cancellation.

PERSONAL AND BUSINESS

Appointments

MR. J. LINNELL has been appointed assistant sales manager of QVF, Ltd.

MR. P. A. CHARMAN has been appointed to the post of sales development manager of Semiconductors, Ltd.

COCHRAN AND CO., Annan, Ltd., has announced the appointment of Mr. A. D. C. Gunn as technical director.

MR. ROBERT L. LICKLEY, M.I.Mech.E., F.R.Ae.S., will be joining the board of Hawker Aircraft, Ltd., on May 16.

MR. W. I. NIELSON has been appointed secretary of Lumenated Ceilings, Ltd., in succession to Mr. H. R. Heaven.

MR. WALTER BRUNDRETT, A.M.I.C.E., has been re-elected chairman of the Chain Testers' Association of Great Britain.

BRITISH RESIN PRODUCTS, Ltd., announces that Mr. G. F. Prescott has been appointed a director of the company.

LANCASHIRE DYNAMO ELECTRONIC PRODUCTS, Ltd., announces the appointment of Mr. E. A. Ward as company secretary.

MR. BRYAN SAMAIN has been appointed to the position of manager, public relations staff, Ford Motor Company, Ltd.

MR. J. A. METCALFE, a director of Minerals Separation, Ltd., has been elected to the board of Foundry Services (Holdings), Ltd.

MR. M. L. JOFEH, A.M.I.E.E., manager, industrial division, has been appointed as an additional director of Sperry Gyroscope Company, Ltd.

JOHN LAING AND SON, Ltd., has announced that Mr. J. W. Charnley and Mr. J. J. G. Michie have been appointed to the board of directors.

MR. A. GEOFFREY BANKS has been elected president of the Engineering Centre, Birmingham, in succession to Mr. Victor Brenner, who has held the office for the past four years.

GEO. SALTER AND CO., Ltd., announces that Mr. F. Eric L. Bache has resigned as chairman. Mr. R. Philip S. Bache, managing director, has also been appointed chairman.

THE GENERAL ELECTRIC COMPANY, Ltd., engineering group, announces the appointment of Mr. E. W. Molesworth as chief engineer for the London, Southern and Eastern areas.

MR. GEORGE TAYLOR has joined the London staff of Moon Brothers, Ltd., and will be responsible for sales in the Southern Counties and export sales from the company's London office.

MR. W. F. AMIES has succeeded Mr. C. V. Oliver as chief executive of the Reed Group's converted products division and has been appointed to the board of The Key Engineering Company, Ltd.

MR. L. H. POMEROY has been appointed director, marketing, United Kingdom operations, of Massey-Ferguson (United Kingdom), Ltd., following the resignation of Mr. T. V. Knox from that position.

LONDON MIDLAND REGION, BRITISH RAILWAYS, announces the following appointments: Mr. M. C. Purbrick, district engineer, Derby (North); Mr. C. L. Parkinson, district engineer, Lancaster; Mr. A. A. Crabb, assistant treasurer, Euston.

DR. PETER AXON, managing director of Ampex Electronics, Ltd., has been further appointed as managing director of Redwood City Engineering, Ltd., the United Kingdom marketing subsidiary of Ampex International S.A. Frebourg, Switzerland.

INTERNATIONAL HARVESTER COMPANY OF GREAT BRITAIN, Ltd., has announced the appointment of Mr. Harold E. Norris as manager of domestic sales. Mr. T. F. Butler has been appointed assistant manager of domestic sales and Mr. J. E. Busby manager of sales engineering, a new department.

THE PATERSON ENGINEERING COMPANY, Ltd., states that Mr. O. C. Kerrison has resigned from the position of managing director and has been appointed chairman in place of Mr. John V. Sheffield. Mr. E. Field Reid has been appointed managing director. Mr. H. W. Coulson has retired from the board of directors after thirty-nine years' service with the company. Mr. D. F. G. Larkman, A.M.I.C.E., Mr. E. A. Oatway and Mr. R. J. O'Donovan have been appointed directors. Mr. Oatway remains secretary of the company.

MR. NORMAN ELLYARD LANGDALE, A.M.I.Mech.E., education officer of Imperial Chemical Industries, Ltd., Wilton Works, has been seconded by I.C.I. to perform the duties of director of practical training and placement at the College of Engineering and Technology, Delhi, for two years, under the technical co-operation scheme of the Colombo Plan.

WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY has announced the appointment of Mr. W. M. Chapman to the newly-created post of general sales manager. He will be responsible for co-ordinating the overall sales activities of area sales, sales in U.S.A., and projects divisions. Mr. David Maxcy, Jnr., has been appointed as director of the projects division, in succession to Mr. Chapman.

Business Announcements

THE INDUSTRIAL FAN AND HEATER COMPANY, Ltd., has moved its London headquarters from Barnet to Remax House, Alfred Place, London, W.C.1 (telephone, Langham 9561).

F. PERKINS, Ltd., Peterborough, announces that a new United States company named The Perkins Engine Company Incorporated has been formed with headquarters in Detroit.

JAMES BURN AND CO., Ltd., 32-38, Saffron Hill, Holborn, London, E.C.1, announces that both factories and offices will be closed for the annual holidays from the evening of Friday, July 22, until the morning of Tuesday, August 9.

MR. J. W. MILLRAY has retired after fifty years' service with the Shap Granite Company, Ltd., but will continue to be a member of the board and act in an advisory capacity. Mr. W. H. Brooks has succeeded Mr. Millray as general manager.

GREENGATE AND IRWELL RUBBER COMPANY, Ltd., Manchester, and CONFLOW, Ltd., Nottingham, have appointed Megator Corporation (the American subsidiary company of Megator Pumps and Compressors, Ltd.) as their sole agent in the U.S.A.

THE FORESTAL GROUP OF COMPANIES, The Adelphi, John Adam Street, London, W.C.2, has purchased the whole of the issued capital of Owen and Green, Ltd., marine and water treatment engineers. Owen and Green, Ltd., will continue to operate under its own name and Mr. W. H. Green will remain on the board of directors.

ELCONTROL, Ltd., Wilbury Way, Hitchin, Herts, states that a factory extension at its works at Hitchin has now been completed, providing substantially increased machine shop facilities. A new special products division has been formed bringing under one control the design, production and application development sections for dealing with customers' individual requirements. The new division will be in the charge of Mr. G. S. Potter.

SCIAKY ELECTRIC WELDING MACHINES, Ltd., Falmouth Road, Slough, in association with PYE INDUSTRIES, Ltd., announce the formation of an Australian company called Sciaky Australia (Pty.), Ltd., to manufacture, install and service resistance welding equipment for the Australasian continent. A factory now under construction at Fairfield, New South Wales, for the new company is expected to be in production by the end of May.

SHORT BROTHERS AND HARLAND, Ltd., of Belfast, United Kingdom, and Focke-Wulf, of Bremen, Germany, announce that they have concluded an agreement in principle under which the Short "Seacat" guided missile system is to be tested for the purpose of evaluation by the German armed forces. Initially, Focke-Wulf will be responsible for supporting the German test programme of "Seacat" and its associated equipment. A subsequent programme of joint development by the two companies is envisaged should the tests prove the missile suitable for German purposes.

Contracts

HOLLAND & HANNEN AND CUBITTS (NORTH WEST), Ltd., has been awarded a contract to build the Merseyside B.M.C. factory. Work is to start immediately, following the award of the £1,750,000 contract from the Industrial Estates Management Corporation for England, and the factory is due for completion within fifteen months. It will cover 350,000 square feet, will cost a total of £3,250,000, and will be used by Fisher and Ludlow, Ltd., for the manufacture of domestic appliances.

THE MITCHELL CONSTRUCTION COMPANY of Peterborough and London has been awarded a contract by the North of Scotland Hydro-Electric Board for the construction of a barrage, intake, small power station and certain ancillary works on the River Awe, near Taynuilt, Argyllshire, for the Loch Awe hydro-electric scheme.

A. MONK AND CO., Ltd., has been awarded a contract by the agent authority, Worcestershire County Council, valued at £3,749,694 for the construction of a further 15 mile length of the Birmingham–Bristol Motorway from Warndon to the Ross Spur. This same firm was awarded the contract for the 12½ mile length between Lydiate Ash and Warndon last month as noted in THE ENGINEER of March 25 last, page 530.

W. AND H. M. GOULDING, Ltd., Ireland, has placed with Simon-Carves, Ltd., a contract for a further sulphuric acid plant of over 200 tons per day capacity. The plant will be in the Dublin area, and is expected to be completed in the summer of 1961. It marks the beginning of the second of Messrs. Goulding's large-scale developments, following its project at Cork, also engineered by Simon-Carves, Ltd., and now nearing completion.

HOLLAND & HANNEN AND CUBITTS (GREAT BRITAIN), Ltd., has been awarded a contract valued at £500,000 for the construction of the new British European Airways Training Centre at Heston, Middlesex. Due for completion in September, 1961, the building will cover an area of 3 acres on the corner of Hayes Road and Southall Lane—adjacent to Heston airport. The training college will have a floor area of 85,000 square feet, with demonstration and technical training areas in a two-storey podium structure, and lecture rooms in a four-storey block above the podium. The building will have an *in situ* reinforced concrete frame and brick external walls, the four-storey block will have white and grey curtain walling with aluminium framed window sashes. An eight-storey tower block will provide 20,000 square feet of hostel accommodation for traffic, engineering, catering, and aircrew personnel undergoing training at the Centre.

WILLIAM BAIN AND CO., Ltd., Constructional Engineers, of Coatbridge and London, has secured a contract, valued at over £30,000, for the supply of 550 tons of steelwork for six bridges for stage 1 of the new Ayr to Prestwick by-pass. The new road is being built to relieve traffic congestion on the A.77, through Prestwick and Ayr. At present this cuts across the main runway at Prestwick airport. Stage 1 of the new road under construction will start from the A.77, north-east of Monkton, and go through Adamton, to Whittletts, a suburb of Ayr, and will pass along the east side of the airport. Three of the bridges are of filler joist construction; the bridge over the B.739 is constructed from universal beam sections, with a concrete deck slab, and the other two, which are over-passes to farms, are steel encased in concrete. Whatlings, Ltd., the main contractor, is undertaking the erection, and the work is being carried out under the direction of the Ayr County Council acting on behalf of the Scottish Home Department.

Miscellanea

SHAW SAVILL LINER.—The keel of the Shaw Savill liner "Northern Star" was laid on Thursday, April 28, at the Naval Yard, Walker, of Vickers-Armstrongs, Ltd.

RULES AND REGULATIONS FOR STRUCTURAL STEELWORK.—A reference was wrongly quoted at the end of an article under the above heading in our issue of April 22. Reference 5 should have read: E. Volterra, "Results of Experiments on Metallic Beams Bent beyond the Elastic Limit," *Jnl. Inst. C.E.*, Vol. 18, page 1, 1943.

NEW ELECTRONICS JOURNAL.—A new international bi-monthly journal, *Solid State Electronics*, is being published by Pergamon Press, Ltd., Headington Hill Hall, Oxford, in order to bring together in one publication outstanding papers reporting original work in various areas of applied solid-state physics. The first issue includes contributions from the Bell Telephone Laboratories, the Royal Radar Establishment, the Sony Corporation of Tokio, and Siemens-Schuckertwerke, A.G., Nürnberg. All papers are preceded by summaries in English, French and German. It is proposed to present at intervals review papers covering important topics in the field of solid-state electronics.

CONTINENTAL AFFAIRS

by Our Continental Editor

German Industries Fair at Hanover

No. II—(*Continued from page 754, April 29*)

AMONG the other exhibits shown by Krupp was the jaw crusher illustrated in Fig. 4, a machine with an output of 150 to 400 cubic metres per hour, depending on the setting of the jaws. Powered by a 180 h.p., 1000 r.p.m. motor, the crusher has an opening of 1800mm by 1400mm. The machine, which weighs about 150 tonnes, is used for the preliminary crushing of pieces up to 1600mm by 2100mm. By contrast with the normal double toggle design with four bearings, there is stated to be just one bearing which is equipped with automatic lubrication, thus reducing wear and power consumption. The drive incorporates a reliable overload protection.

A system of lightweight roof construction was being shown, using as supporting elements cold-rolled thin box sections suspended from cables. The demonstration hall is subdivided into two bays, respectively 7m and 21m wide. Corrugated plastic sheet is used for the peripheral curtain walls which do not extend to ground level, thereby leaving the access unobstructed by columns or other structural parts.

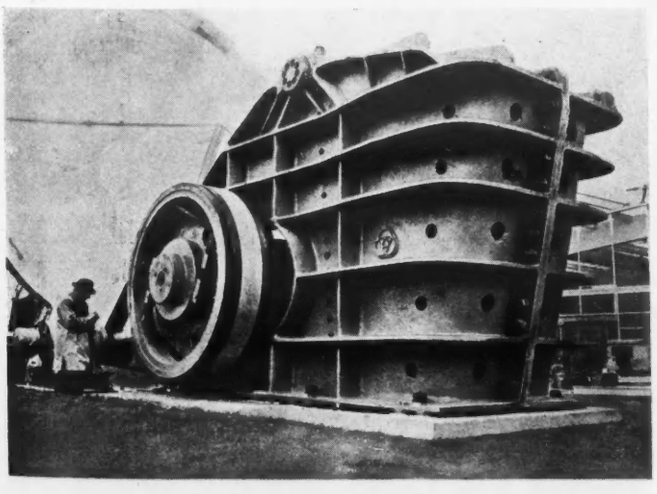


Fig. 4—Jaw crusher for 150 to 400 cubic metre hourly output

H. Liebherr

In the open-air exhibition, H. Liebherr, Biberach/Riss (Wttbg), showed the "Model 6A" tower crane with 1100 kg capacity at 5m radius (jib height 24·3m) and 440 kg at 13m (jib height 16·2m). Stationary or rail-mounted, this crane possesses a folding tower and jib for convenient road transport. Also shown was the larger "Model 11A/13" (1550 kg at 6m radius, height of jib 31·7m) which is equipped with a telescopic column.

The "Model HB" building crane was demonstrated as a rail-mounted slewing tower crane with curve-negotiating undercarriage, as a climbing crane, and as an externally-braced crane. These cranes are self-erecting, the externally-braced design up to a height of 300m. Derricking of the level-luffing jib is hydraulic. The jib is hinged to the tower platform at its rear end, thereby leaving a space free in the centre of the slewing circle for erecting and dismantling the telescopic sections. The design, which is available in four sizes from 12 to 50 tonne-metres capacity, can be equipped with high-speed electric hoist gear giving hoist speeds up to 145m per minute. Magnetic disc clutches facilitate gear changes and remote control from a portable panel. An electric device, "Pondomat," warns the crane driver in case of overload and finally stops the crane.

In the rail-mounted variants, the "Polyp" undercarriage is a square box with four arms hinged at the corners, on which are mounted the wheels in housings which can rotate about a vertical axis. The arrangement allows the crane to travel on a track having a variable gauge and curves as sharp as 3·5m inside radius.

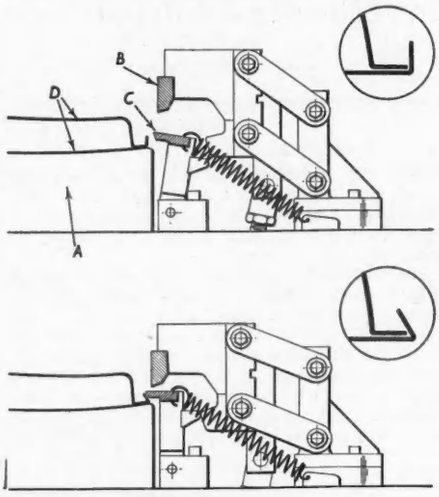
An automatic batching and mixing plant (Fig. 5) has a cylindrical tower divided by radial walls into eight compartments for sand and aggregates, with a central cement silo. A feed screw for the cement and vibratory chutes for the other materials supply the electric weighing machine, which incorporates punched-card preselection of components and automatic reporting. This equipment is situated at the level of the control room. A dividing hopper feeds the batches with or without water to two mixers situated immediately below the control stage, after which the concrete of the pre-mixed constituents is loaded on to lorries. In the case of the tower shown, the diameter of the shell was 6m and the overall height of the steelwork about 14·2m. The whole plant is capable of being dismantled into smaller sections for road transport without dismantling the electrical set-up. Erection, it is stated, requires about one week. Only one man is required to supervise the plant and to give the starting commands. The state of the bunkers is continuously indicated by warning lights. Hourly capacity, depending on the design, is quoted as 25 to 160 cubic metres.

Fig. 5—Concrete batching and mixing plant. The silos can hold 260 cubic metres of aggregate and 90 tonnes of cement. Total weight: empty, 70 tonnes; full, 600 tonnes

British Federal Welder and Machine Company

On the stand of British Federal Welder and Machine Company, Ltd., Dudley, was shown an hydraulically-operated automatic clinching fixture for the production of automobile body doors, trunk lids or similar components. It replaces two-stage press tools requiring large

CONTINENTAL AFFAIRS *(Continued)*



A—Platform.
B—Main clinching beam.
C—Pre-clinching beam.
D—Workpieces.

Fig. 6—Hydraulic clinching machine

power presses or costly hand operations. The machine (Fig. 6) comprises a main base clinching cradle *A*, clinching beams *B*, and pre-setting beams *C*, as well as a hydraulic pressure unit. In operation, the previously retracted clinching beams swing forward and downward. In so doing they engage with the pre-setting beams which pre-clinch the flanges to 45 deg., and are then retracted to clear the path of the clinching beams which complete the job.

Huther and Co.

A transportable drying and mixing plant for bituminous mixes (stabilisers) was exhibited by Huther and Co., Bechtheim, near Worms. The machine, which is seen in Fig. 7, incorporates a mixing drum in which sets of radially projecting stub blades pitched in opposite directions impart a to-and-fro movement to the mix as it slides down towards the discharge end. The machine is stated to be suitable for a wide range of aggregates, from coarse to sand, and to have an output of 90 to 100 tonnes per hour (daily average, 700 tonnes). By means of a small bucket conveyor the aggregate is first fed into a weighing machine from which small, rapidly successive batches are transferred to the mixing drum, which from the outside is heated by oil-fired burners. After impregnation the aggregate and bitumen are thoroughly mixed by the blades and discharged into a hopper from which weighed amounts can be transferred to lorries by a conveyor.

Karl M. Reich Maschinenfabrik

For driving nails from 35mm to 70mm with a single blow, the firm Karl M. Reich Maschinenfabrik showed the "Holzher Model NB-7/B" pneumatic hand nailing equipment. This comprised a gun joined by a 5m long connection to the nail magazine, which also contains the sorting device and the pressure-reducing valves for the air supply. It is possible with this equipment, by interchanging the bolt for one of different length, to leave the nail heads standing up, flush, or punched in ; if necessary, the nail can be struck twice or more often by pulling the trigger of the nail gun. The control line, which initiates the pneumatic delivery from the magazine of the next nail, remains blocked until the driving bolt has descended to the end position. A safety catch prevents accidental discharge, but in any case the nail cannot leave the barrel unless the muzzle is pressed against the wood. For turning back the points, the nails are driven at an angle through the wood against a steel plate ; a special barrel with bevelled muzzle is used. It is stated that sixty to 100 nails can be driven per minute. Nails which are too long to fit the machine can be driven lightly with a hand hammer and then fully with the pneumatic tool, which requires an air pressure of 7 to 8 atmospheres.

Beck and Henkel

A hydraulic end tippler for railway wagons was shown by Beck and Henkel Maschinen Bau-Aktiengesellschaft, Kassel. The device does not involve a break in the track which could cause derailment through faulty closure. It comprises a foundation frame on the top of which the track is carried. Between the rails and below their level in the resting position lies the tippler arm, a rigid fabricated flanged girder frame. This is hinged at one end to the foundation, and can be raised up to 65 deg. by means of two 45-ton hydraulic jacks. The wagon, which discharges into a bunker immediately ahead of the tippler, rests with its axles on an inclined front support and on a forked rear support, the latter being adjustable to suit any wheelbase up to 6m. Near the front support is a two-stage wheel brake which first stops the wagon and then blocks the front wheelset, after which the tippling arm may be raised.

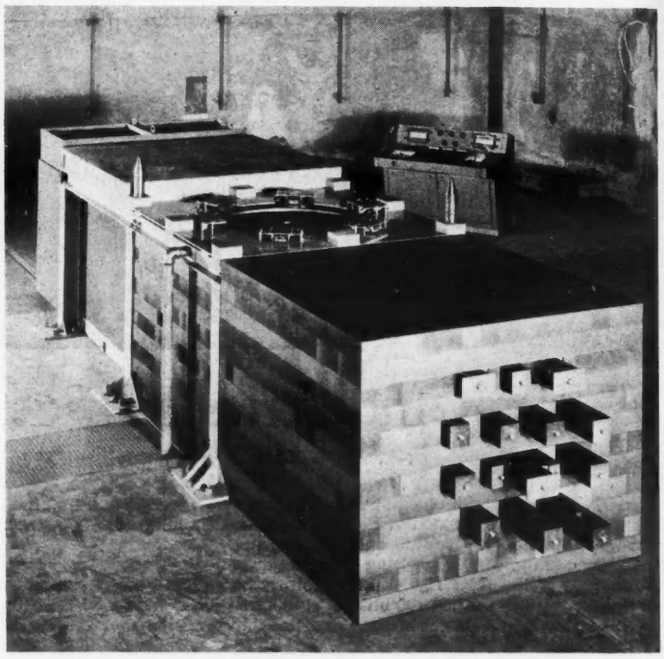


Fig. 8—Core of "Argonaut" reactor without shield or water system

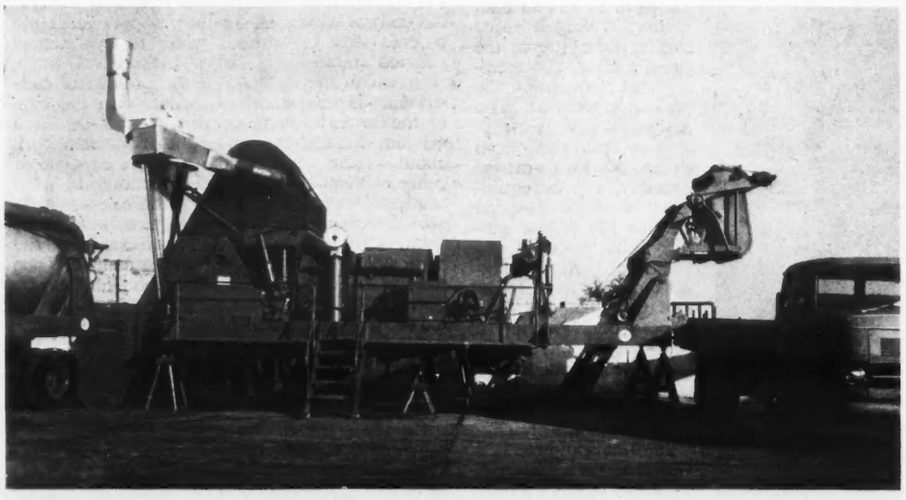


Fig. 7—Drying and mixing plant for bituminous mixes

Siemens and Halske Aktiengesellschaft Siemens-Schuckertwerke Aktiengesellschaft

As usual, the principal stand of the Siemens concern was situated in Hall 13: in the open area outside were also to be seen some larger items and a model of the "Argonaut" reactor. Elsewhere, Siemens was represented with its domestic electrical equipment (Hall 10), radio and television (Hall 11), and the Aeronautical Exhibition at Hanover Airport at Langenhagen. Because of the very wide range of products, it was only possible to show a cross-section of the output, and certain standard lines had to be omitted entirely. The exhibition endeavoured, by means of a careful selection of objects, to illustrate the wide sweep of the designs which have been or are being developed in the field of heavy and light current electrical engineering, telecommunications, and measuring technique.

The Siemens "Argonaut" Reactor at Garching near Munich (SAR), Fig. 8, is a research reactor based on a prototype of the Argonne National Laboratory. Its main characteristic is flexibility based on a system of unit construction ; the obtainable flux density ranges up to 10^{11} neutrons per square centimetre per second. In addition to such questions as core design, absorption cross sections, and fuel burn-up, the reactor is intended to serve as neutron source for exponential experiments and criticality determinations. With a portable water tank (similar

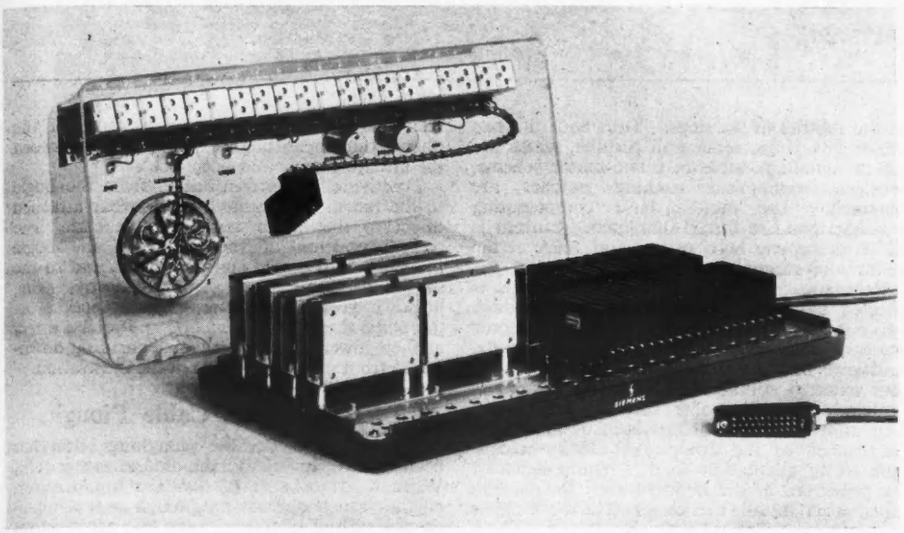


Fig. 9—" Simatic " speed control for an eight-step gearbox for a machine tool headstock. The gearbox is operated by means of electro-magnetic clutches

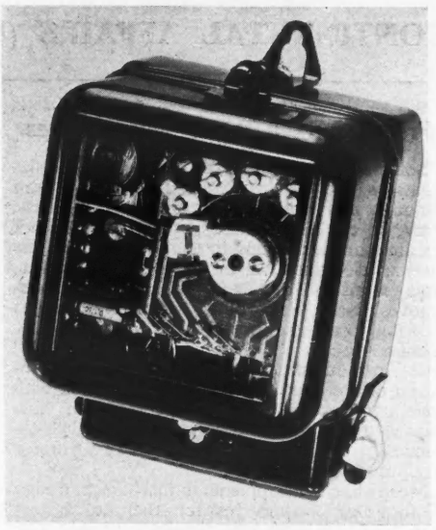


Fig. 11—Audio-frequency operated selector switch

to the " bulk shield " which preceded the " swimming pool ") it is possible to carry out shielding tests. The core is laid out in the form of a ring which leaves a central space for an inner thermal column which can be used for measuring the properties of the fuel arrays of power reactors. The reactor first reached criticality on June 23, 1959.

Many exhibits demonstrated the " Simatic " transistorised control system which, in the absence of mechanical contacts (it works entirely on an electronic basis), can carry out up to 10,000 switching operations per second. The basic logical operations have been reduced to five, for which small flat rack-mounting units are made in which the components are embedded in plastic. Complete control units for any purpose can be set up by means of a number of such units which can easily be exchanged.

As an example, Siemens showed a speed control for a six-speed forward/reverse headstock spindle (Fig. 9). The headstock, made by Zahnradfabrik Friedrichshafen, uses magnetic multiple-disc clutches, two for each of three planetary gears, and one each for each sense of rotation. The driving motor is incorporated within the headstock.

The electrical control can pre-select any speed, which can then be put into operation. The speed is automatically controlled at the set figures, the average over short interval being counted in successive electric counts by a Hall generator and indicated in four-figure digital form. Fourteen capacitative buttons (contactless switches) are employed to transmit the commands to the control unit.

The control of a h.t. switching station was also demonstrated at Hanover. This comprised all the elements for actuating the switches, interlocking against faulty switch or system operation, and the automatic safety devices. The control works without auxiliary contacts between command input and signal amplifier.

An automatic maintenance-free control for a six-compartment slurry silo demonstrated the possibilities of industrial programme operation with the help of " Simatic " components. In this case the crude slurry, used in the manufacture of cement, has to be kept in suspension and well mixed by blowing in air at certain intervals. After blowing each cell six times the process is repeated with the next cell, and so on. Provision is made to vary this programme to suit special circumstances (no blowing if cell is empty, continuous blowing also out of sequence when material is removed from cell). Absence of mechanical contacts, short control cables and great reliability are stated to make the small and light equipment very suitable also for the tropics where the wet cement process is mostly used.

Another application is to the control of ignitions in welding machines, such as the spot welder shown in Fig. 12. Here, all component times of the welding cycle are accurately maintained by counting the mains frequency period (20 milliseconds). The power control and any variation of the current are carried out with flip-flops also embodying " Simatic " elements.

An audio-frequency operated control switch, forming part of a centralised warning and control system, is illustrated in Fig. 11. Such systems are used to switch street lighting, double-tariff meters, domestic hot water boilers and similar low-power consumers. Another application is to alert fire brigades, and other emergency services. The new receivers (switching or simple receivers) are operated by coded impulses at 2000 c/s which are superimposed on the 50 c/s mains frequency. The receivers respond already to comparatively small audio voltages. They are insensitive to short or long disturbing voltages and are thus protected in a great measure from malfunctioning.

The 2000 c/s control frequency is fed into the low-voltage circuits directly by means of amplifier transmitters remotely operated from the central control point over auxiliary lines. This method avoids the expense of a high-power central transmitter together with large numbers of matching components, while enabling the network to be extended in a simple manner.

A protective relay which switches off in 0·1 second on the occurrence of a fault current exceeding 0·5A is shown in Fig. 10. In its operation, the " SFJ " switch is based on the blocking of a permanent magnet by means of a field due to the fault current. This pulls out the switch under spring pressure, so that the action is entirely independent of the mains voltage. For instance, even if all three conductors are " dead," the relay still gives protection against dangerous voltages imported via the small conductor. Since fault currents often, through arcing, convert an earth fault into a short-circuit it is of advantage to have a switch which is capable of coping with the full short-circuit current. The two-pole 40A version, as well as the four-pole, 25A and 63A versions, is laid out for sensitising currents of 1500A.

Fig. 10—Protective relay for fault currents, mounted in insulated casing (cover removed)

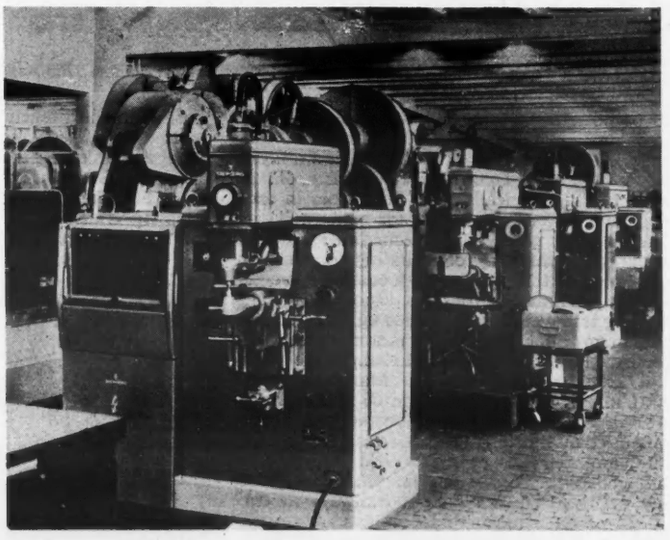


Fig. 12—Spot welding machine with " Simatic " ignition control

(*To be continued*)

CONTINENTAL AFFAIRS *(Continued)*

French Mixed-Traffic Locomotives

Some 2400 route-miles of the French National Railways are electrified at 1500V d.c., and although new work is being undertaken on the 25kV, 50 c/s, single-phase system, extensions of d.c. lines are continuing in the South. Since the pre-war electrification of the P.O.-Midi lines, large numbers of B_0-B_0 mixed-traffic locomotives have been built, successive designs showing progress in various directions and culminating in the highly versatile "8100" series introduced for the Paris–Lyons electrification of the South Eastern Region, which with their compensated motors operate with nine steps of field-shunt and so provide twenty economical running notches with two motor groupings.

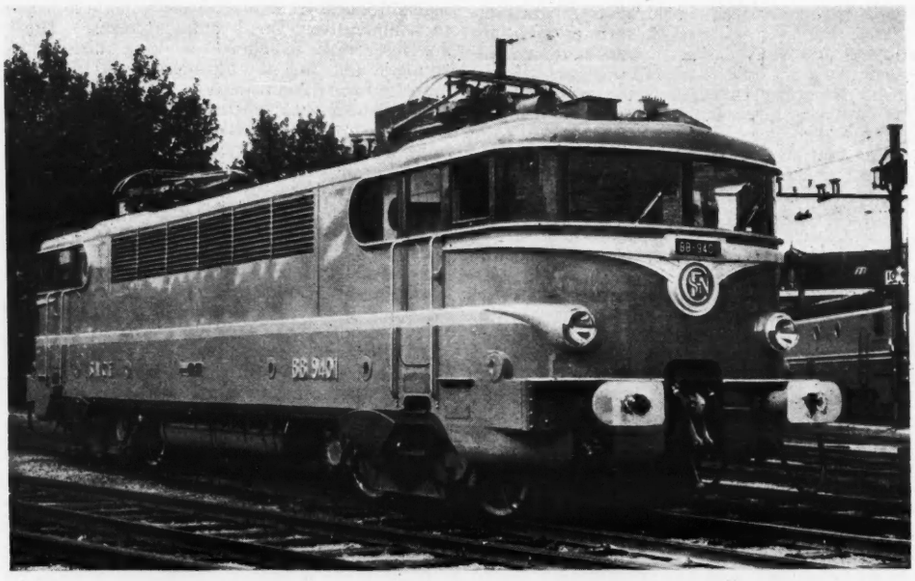
Meanwhile developments in mechanical design of four-axle locomotives for the a.c. system have influenced the new "9400" mixed-traffic series for 1500V d.c. electrification which we illustrate. This is the first French d.c. locomotive to be powered by one motor in each bogie. It is one of sixty being built by the Société Fives-Lille to the requirements of the Division d'Etude de la Traction Electrique (D.E.T.E.) of the French National Railways. Both axles in each bogie are driven from the motor pinion through intermediate gears, the mechanical coupling obtained in this way contributing to adhesion and enabling this lightweight locomotive, weighing only 60 metric tons, to exert an average starting tractive effort of 21,600 kg or 31,000 kg maximum at the limiting motor current of 1350A. Power ratings are 3130 h.p. (one hour) and 2900 h.p. (continuous). Maximum speed is 81 m.p.h., as compared with 66 m.p.h. in the "8100" class mixed-traffic locomotives, which weigh 92 metric tons (with normal ballast) for similar horsepower ratings.

Single-motor bogies were first used operationally on the French National Railways in two prototype dual-frequency locomotives for inter-running between the French 25kV and Swiss 15kV a.c. systems. Their first large-scale application was in the "16500" class mixed-traffic locomotives introduced at the time of the Paris–Lille 25kV a.c. electrification at the end of 1958, in which a variable-gear ratio is also incorporated to extend the range of duties on which the locomotives may be employed. In the new d.c. mixed-traffic locomotives, however, the gear ratio is fixed, but a wide range of characteristics has been obtained by going down to 30 per cent field in the motors in six steps. Thus with the two motor groupings, series and parallel, which are the maximum possible in a two-motor scheme, fourteen economical running notches are obtained. The motors have compensating windings and are forced-ventilated. Current is 825A at the one hour rating, and 760A at the continuous rating.

Resistance notching in twenty-eight steps is effected by a new rotary controller in which two contact arms driven by an air servo-motor traverse concentric tracks connected to the resistance banks, operating in conjunction with four external contactors so that no current is broken at the controller contacts themselves. This control equipment has been designed and constructed by the Compagnie Electro-Mécanique as an adaptation to d.c. requirements of the principles of the Brown-Boveri low-tension tap-changer installed in certain a.c. locomotives of the German Federal Railway.

Mechanical details of the locomotive are similar in principle to those of several a.c. classes on the French National Railways. The motors are fully-springborne and the final drive is taken through the standard form of hollow cardan shaft enclosing the axles and articulated on "Silentblocs." A "Silentbloc" resilient coupling is also introduced between the motor shaft and its pinion to provide the torsional resilience considered necessary because of the direct coupling through ordinary gears between the armature snaft and both axles.

Tractive effort is transmitted from the bogie to the locomotive frame by a drawbar attached direct to the motor frame at one end. The central position of the motor in the bogie prevents the use of a normal bolster, and so the secondary suspension is provided by swing links supported from strengthened sections of the bogie frame side members, and joined direct at their lower ends to brackets extending downwards from the body as seen in the illustration.



Two-motor locomotive with coupled axles for French National Railways 1500V d.c. lines

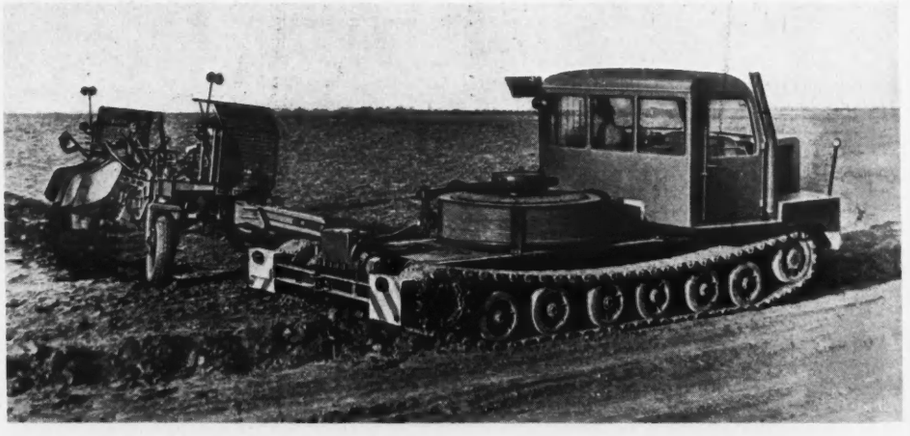
Diesel-Powered Cable Plough

A diesel-powered cable ploughing outfit has been developed by V.E.B. Mähdrescherwerk, Weimar. It consists of two 175 h.p. traction engines which operate the plough over a maximum length of furrow of 560m, the cable drums holding 600m apiece.

The cable tractor is equipped with a six-cylinder diesel engine of 180 h.p. continuous rating at 1500 r.p.m. and four-speed forward/reverse gearbox, used for travel as well as winching, giving travelling speeds of up to 8·15km per hour, and cable speeds up to 7·85km per hour. The vehicle measures overall 6180mm by 2600mm by 2240mm height and has a ground clearance of 300mm. The maximum gross weight of 16,000 kg is spread over two 400mm by 3100mm track contact areas, limiting the ground pressure to 0·65 kg per square centimetre. The maximum available cable pull is 6·1 tonnes in top gear and 12 tonnes in first.

The plough is equipped with two sets of four to five shares attached to either side of the central boom and facing in opposite directions. The combined ploughing width is 140cm to 175cm. By rotating the boom about its longitudinal axis, the direction of working can be reversed. The plough is supported on two pneumatically-tyred wheels, front and back, and an outrigger wheel off the centre. The end wheels can be steered from their respective driving seats, steering being applied to the wheel leading during each traverse, so that either two drivers are required, or a single driver has to change position when the plough reverses. Protection from the whip of the cable in case of rupture is provided by a heavy wire shield in front of each plough driver and bars over the near side window of the tractor cab. The crews of engines and plough communicate by means of light signals.

Cable ploughing is stated to be particularly applicable to heavy and heaviest soils with a high amount of moisture, where ordinary tractors cannot be used. As the tractor is kept off the field it does not solidify the ground. Depth of ploughing is up to 35cm, and a crew of three to four men is stated to be able to plough about 8 hectares per day.



One of the two traction engines and the reversing plough of diesel-powered cable ploughing outfit

THE AMERICAN SCENE

by Our American Editor

Common Transfer Machine for V-6 and V-12 Engine Blocks

THE application of " building block " design to transfer machines has permitted an American truck manufacturer to install a single " Transfer-matic " instead of two machines. The operations performed on this transfer line, which was designed and built by the Cross Company, of Detroit, Michigan, include boring, reaming, tapping, chamfering and spotfacing either V-6 or V-12 engine blocks. Of the 579 operations performed on the V-6 block and the 901 on the V-12 block, 454 operations are common to both. Since it is produced in lower quantities, the V-12 block was designed as two V-6 units cast together. Details common to both blocks include identical cross sections and hole patterns, front and rear, and identical cylinder head mountings. In the design of the new line, the V-6 block was considered as the basic unit.

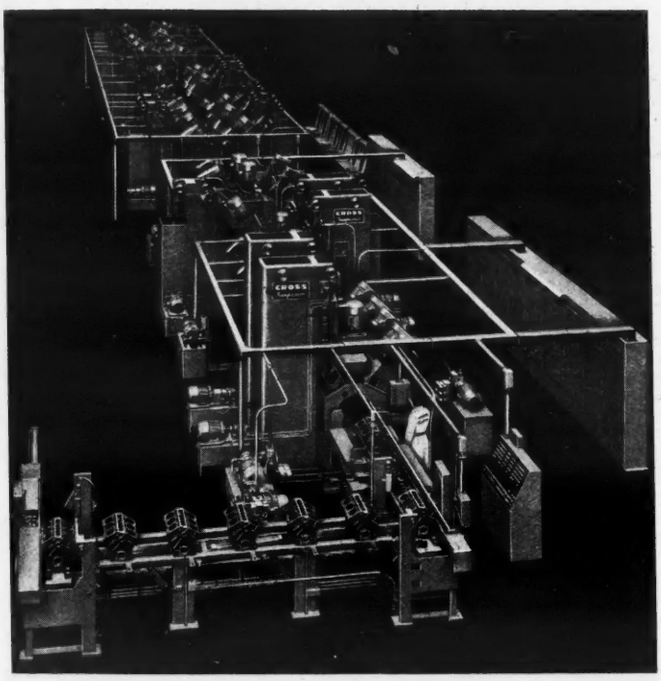
The 450ft long transfer line looks like a flattened " S." The middle leg is a 100ft long accumulating conveyor that joins the machining sections and is instrumental in maintaining steady production during change-over from one block to the other. The line is divided into sections with a provision for banking between each section. The removal of parts for banking is manual, and the bank area has no set capacity. Because of the provision for banks of parts and the accumulating conveyor, one section of the machine can be producing V-6 blocks, another one can be working on V-12 blocks and others can be in the process of change-over. To prevent damage to the heavy parts, lift-and-carry transfer mechanisms are used throughout the machining sections. The construction of the line with " building block " units offers flexibility for future part-design changes or even for processing entirely different parts. Included in the eighty-two-station line are twenty-five idle stations, which prevent heat build-up in the blocks or fixtures and provide room for servicing the present stations and adding future operations.

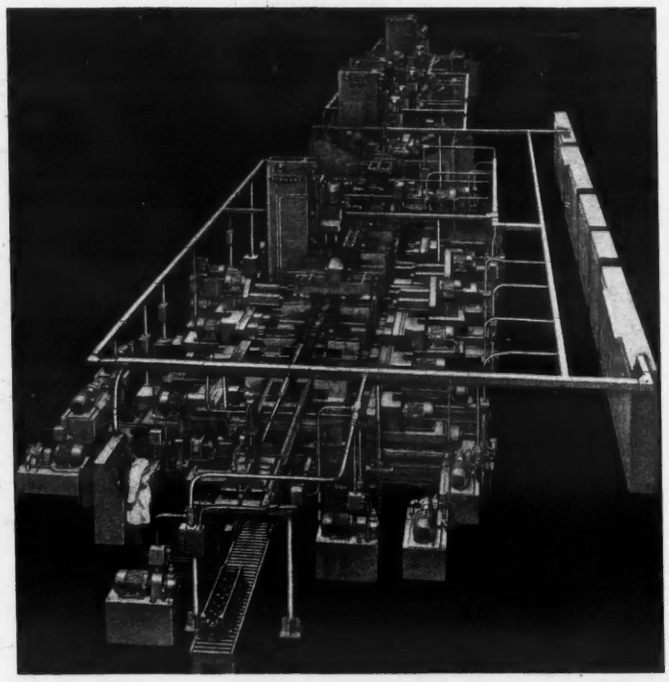
The V-6 blocks move through the line conventionally but, to accommodate offset, identical hole patterns and double patterns, the V-12 blocks move differently. In some stations, the block is shuttled to one side, at other stations the drill heads and bushing plates are shuttled, and in other stations the V-12 block stops twice under each multiple-spindle head. In two-stop transfers, the front half of the block is machined at the first stop and the rear half is machined at the second stop. This double cycle is used for the V-12 blocks, instead of doubling the number of machining heads, because the lower production requirements of the V-12 units would not have justified the additional initial cost. The time added by the double cycle is not prohibitive.

Deep oil-gallery holes are drilled progressively in one section of the machine. These holes extend the full length of the block and are drilled halfway from each end. Five passes are used with V-6 blocks and eight with V-12 blocks to complete the holes.

Each of the four Cross machine sections can be changed over from production on one block to production on the other in an average of four man-hours. With conventional equipment, a similar change-over would require up to two weeks per section. To simplify set-up, spindles and tools are coded. Two rings machined in a spindle or tool indicate that it is used only on V-12 blocks ; one ring indicates it is for V-6 blocks, and no marking shows that it is common to both blocks. Both cemented carbide and high-speed steel tools are used in this line. The carbides are used for boring at speeds of 200ft to 300ft per minute and for reaming at 100ft per minute. Drilling and tapping is performed with high-speed steel tools within a speed range from 40ft to 70ft per minute.

About 170 in-process inspections are performed on the V-6 blocks and 231 are performed on the V-12 units. If a defective part or a broken tool is detected, the machine stops and the block is manually removed to the salvage area. Its place on the line can be filled by a partially machined part, or that spot can remain open. In production, the line can machine any of three different versions of V-6 blocks in fifty-four seconds. The V-12 blocks are processed in under two minutes. The capacity of the line, at 100 per cent efficiency, is thus either sixty-five V-6 blocks or thirty-five V-12 blocks per hour.





Figs. 1 and 2—(Left) V-12 engine block entering the first two sections of " Transfer-matic " machine. (Right) V-6 engine blocks coming off the accumulating conveyor and entering the final sections of " Transfer-matic " machine

THE AMERICAN SCENE *(Continued)*

Automatic Tungsten Inert Gas Fusion Welding Machine

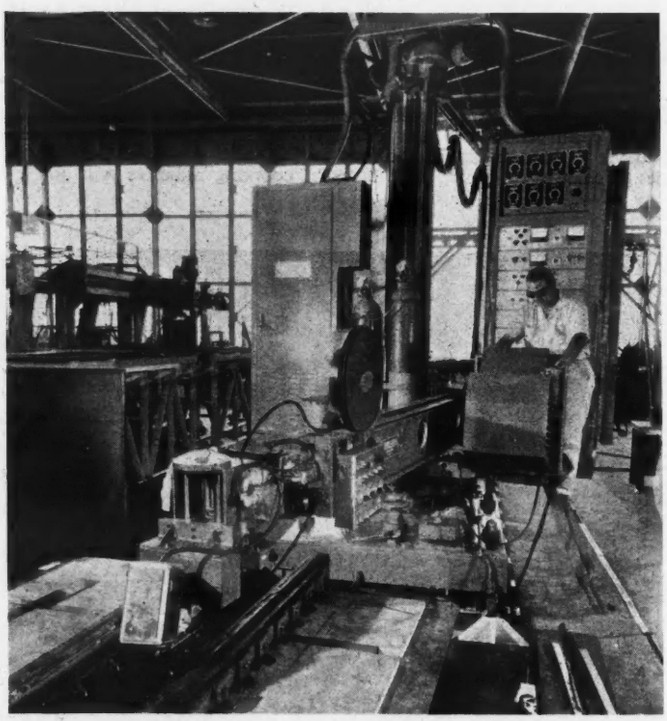
Two fully-automatic fusion welders of the boom manipulator type were recently built for the Los Angeles Division of North American Aviation by Sciaky Brothers, Incorporated, of Chicago. For the past ten months, the machines have been used successfully in the Tungsten Inert Gas (T.I.G.) welding of various sub-assemblies including brazed honeycomb configurations. The equipment has been tested in welding high-heat-resistance heat-treatable alloys of various configurations and eventually will be used in the manufacture of the B-70 intercontinental bomber.

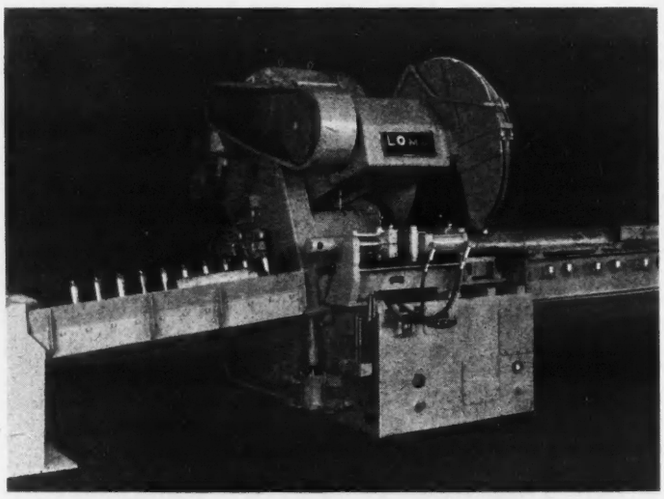
Normal procedure in welding cylindrical sections is to set the welding torch in a downhand position and to rotate the workpiece. This becomes impractical when working with complex shapes, such as air intake ducts. With the boom manipulator welder, North American has now welded in practically every position, i.e. with the torch in a conventional position of vertical or downhand horizontal, at either three o'clock or nine o'clock, or directly overhead. Actually, all of these positions are part of the capability of the machine to weld continuously through a complete circle of 360 deg. Thus, it is now possible to weld circumferentially inside a cylinder, with the torch rotating about the centre-line of the powered face plate which is situated at the end of the boom.

Special step weld controls have been provided to change the weld settings automatically as the material thickness changes and to produce consistently complete welds of uniform penetration. The adjustment for the welding parameters is made at two stations ; one control station is situated at the end of the boom and the other one at the main control console. A push-button on the main console preselects the activity of the main or auxiliary control. This selector switch is supplemented with a limit switch actuated by a dog on the boom. By setting the dog in the same position as the step change in the work thickness, the weld is made automatically and completely. When the step in thickness is reached, the dog will initiate a signal to change stations and weld settings.

The movements of the machine include in-and-out weld motions of the main boom, 360 deg. torch rotation and fine horizontal or vertical head adjustments on the torch face plate. The boom can rotate a full 360 deg. about the main column, as well as move up and down the same column, from 3ft to 10ft above floor level. An extension of the main boom permits an effective weld length up to 12ft. Internal circumferential welds can be made automatically in ducts down to a 20in diameter. All the positioning controls which are in operation as welding is taking place utilise a transistorised zero-error drive. This precisely regulated, highly responsive motor control is an electronic counterpart of the rotating amplifier principle. The zero-error control enjoys the same basic characteristics as the rotating amplifiers, such as nearly perfect linearity and reversibility, and is, in addition, a static device. Its speed of response is very close to the theoretical maximum obtainable with 60 c/s a.c. power. Acceleration from zero speed to any preset speed is within five cycles with negligible overshoot. Within three cycles, deceleration to a complete stop is obtained by means of regenerative armature braking. Complete reversibility of direction also only takes three cycles.

A special seam tracking system is used to maintain the alignment of the torch directly over the seam to be welded. It is also capable of sensing a butt joint, and then tracing this seam as the head moves. Accordingly it is possible follow a vagrant seam as much as 4in " off " an axis in both, or either, the horizontal and/or vertical plane. The firm has designed its own filler wire drive unit, power source and arc control length systems. Its complete d.c. power source ranges between 2A and 300A. The use of a feedback system in the control circuit together with a null transducer ensures a constant setting. An arc length control system and proximity transducer unit attached to the torch provide a constant tungsten arc spacing. A television camera is set adjacent to the welder head ; the receiving screen of this closed circuit is situated on the operator's platform directly opposite to the main control console.





(Left) Automatic Sciaky tungsten inert gas fusion welding machine of boom manipulator design used to weld heat-resistant alloys. (Right) 48in diameter Loma circular sawing machine for cutting aluminium alloy billets

Automatic Cold Sawing Machine for Aluminium Billets

A SINGLE operator can now cut large aluminium alloy billets faster, with closer length tolerances and with very smooth surfaces, thanks to the development of an automatic cold sawing installation by the Loma Machine Manufacturing Company, of New York. The new equipment employs the large, hydraulically-operated circular saw which is shown in the accompanying illustration. Designed to cut aluminium alloy billets up to 16in diameter, the machine is equipped with a 48in diameter sawblade driven by a 75 h.p. motor at speeds between 4000ft and 8000ft per minute.

The machine employs a tilt arm, and the cut is effected through a downward movement of the sawblade. This arrangement results in the feed pressure being taken by the rugged housing, eliminating any risk of chatter during the cut. The feed speed is smoothly adjustable, and the automatic return of the tilt arm occurs at high speed, holding idle time to a minimum. The sawblade rotates in such a direction that chips and coolant are carried away from the operator and are disposed of through an automatic chip conveyor. Complete automation is obtained by operating the saw in conjunction with mechanical handling equipment consisting of a billet storage table with an escapement feed, a powered feed, roller conveyor, an automatic length gauging stop and a gravity discharge roller conveyor. All this equipment can handle billets up to 18ft length and 16in diameter.

The entire billet conveying and sawing installation begins to work on an automatic cycle once the operator actuates the escapement push-button. The most advanced billet leaves the storage table and is entered into the saw by the feed conveyor. In the meantime, the length stop has swung into position ready to halt the advancing billet. The hydraulic clamp of the machine now grips the billet, the stop swings out of the way, and the saw cut is made. The cut billet travels down the discharge conveyor and is removed to the storage rack. Meanwhile, the clamp has been released upon the return of the saw tilt arm, the length stop has again swung into position, and the billet is then advanced by the feed conveyor for the next cut.

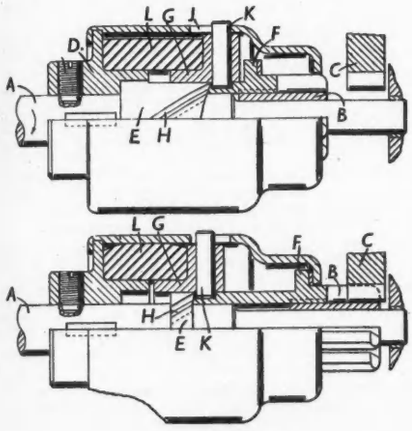
BRITISH PATENT SPECIFICATIONS

The dates printed are those of application and publication on completion. Copies of specifications may be obtained at the Patent Office Sales Branch, Southampton Buildings, Chancery Lane, W.C.2, 3s. 6d. each

INTERNAL COMBUSTION ENGINES

832,272. June 21, 1957.—ENGINE STARTER DRIVE, Bendix Aviation Corporation, 401, North Bendix Drive, South Bend, Indiana, United States of America.

The invention is described with reference to the accompanying drawings. A power shaft *A* has on it a pinion *B* which is slidable into and out of mesh with an engine gear *C*. A driving head *D* fixed on the power shaft has a barrel member rigidly mounted on it. The free end of the barrel is formed with an inwardly extending flange with which the pinion sleeve *E* provided with a radial flange *F* comes into contact when the pinion is fully meshed with the engine gear *C*, as shown in the lower view. The abutment so provided thus serves to define the meshed position of the pinion, and the flanges also form a clutch for transmitting torque from the barrel to the pinion during the cranking operation. Preferably a ring of suitable wear-resisting frictional material is interposed between the flanges. An



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annular collar *G* is mounted in the barrel, bearing on the sleeve *E* of the pinion. The sleeve has a helical slot *H* and the barrel an axial slot *J*. A pinion traversing member in the form of a pin *K* is fixed in the collar *G* with its inner end seated in the slot *H* of the sleeve and its outer end traversing the axial slot in the barrel. An annular block *L* of elastic material such as rubber is located in the barrel between the driving head and collar *G* and is normally held under a slight initial compression. In starting, rotation of the power shaft by the motor is transmitted through the driving head and barrel to the pin. The rotational inertia of the pinion member causes the rotation of the pin to traverse the pinion to the right by reason of engagement of the pin in the helical slot, until the travel of the pinion is arrested by engagement of its flange with the flange of the barrel. Since the forward movement of the pinion is thus arrested, further rotation of the power shaft causes the collar *G* to be moved back against the pressure of the elastic member *L*, thereby cushioning the shock of the meshing engagement and compressing the clutch for the transmission of torque directly to the pinion, supplementing the torque transmitted through the pin. The frictional connection so provided serves to damp torsional vibrations and prevent premature demeshing of the pinion. When the engine starts, the over-running of the pinion causes the pin to return it to idle position, where it is yieldably maintained by any suitable means.—*April* 6, 1960.

TUBES

831,992. February 19, 1957.—HIGH PRESSURE TUBES, Babcock and Wilcox, Ltd., Babcock House, 209/225, Euston Road, London, N.W.1.

This invention relates to tubes suitable for withstanding high stresses due to large internal pressures such as in modern boiler plant. According to the invention, a tube for withstanding high internal pressures has an inner tube encircled at intervals along its length by reinforcing bands each comprising a flat spiral of steel strip tightly wound perpendicular to the length of the inner tube. Preferably the ends of the final turns of the reinforcing spirals are secured by welding. If additional strengthening is required against axial stresses the tube may include strengthening strips extending parallel to the length of the inner tube and symmetrically arranged around it beneath the reinforcing bands, each strip being welded at its ends to the inner tubular part. The strengthening strips effectively increase the cross-sectional area of the tube and hence its strength to axial stresses. Heating lines or elements may also be included in the structure of the reinforced tube. Various forms of reinforced tube are illustrated in the specification.—*April* 6, 1960.

MINING EQUIPMENT

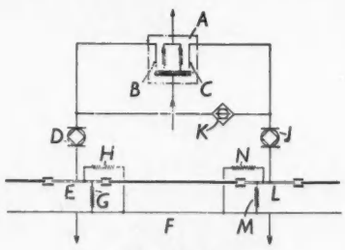
831,740. January 7, 1958.—ANCHOR BOLTS FOR LINING SHAFTS, Veruschacht Vereinigte Untertag-und Schachtbau G.m.b.H., 2, Westendstrasse, Essen, Germany.

According to this invention, a hollow, perforated rock anchor bolt is provided with a shield that is movable so as to control the number of perforations that are exposed for the passage of binding medium into the bore in the rock. The bolt is of particular advantage for the securing of the lining in a shaft sunk into the rock that has been artificially frozen. With the bolts initially secured deep in the rock, well beyond the shaft perimeter surrounded by a ring of frozen rock, the binding medium can be forced through perforations near the points where the inner ends of the bolts are secured to the firm rock. These inner perforations are selected by positioning the shields, after which the frozen rock extending to the shaft perimeter may be thawed out, and dewatered if necessary, and binding medium can then be forced into it, by repositioning the shields to expose fresh perforations, in as many stages as the conditions make desirable.—*March* 30, 1960.

RAILWAY SIGNALLING

831,373. March 25, 1958.—TRACK CIRCUITS, Société Technique pour L'Industrie Nouvelle, S.A. "Stin," 2, Rue du Jura, Vevey, Switzerland.

This invention is concerned with railway track circuits employing short insulated rail sections defining the ends of a track section and earthed by the passage of a train over them, so that current can flow through a track signalling relay which is in circuit with the insulated rail section. With relatively short insulated rail sections it is easier to use a system in which a circuit is completed for the flow of a current (open circuit system), rather than the system in which a circuit having a current flowing in it in the normal condition of the equipment, is broken and the current interrupted (closed-circuit system) as used on long track sections. However, with the open circuit system the safety factor is reduced to the extent that faulty interruption of the circuit is not



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automatically indicated, and this may give rise to dangerous situations. It is an aim of the invention to overcome this defect. Referring to the drawing, a thermally operating mercury switch *A* acts as a change-over switch and, alternately, connects a source of electric current, indicated by the upwardly-pointing arrow, first to one contact *B* and then to the other contact *C*. It is arranged that only one of these contacts is closed at a time and, furthermore, if the switch comes to rest it can only do so with both contacts *B* and *C* open. The contact *B* is connected to one side of the coil of a track relay *D* corresponding to an insulated rail section *E*, to which the other side of the coil of that track relay is connected. Rail section *E* has a natural impedance through earth to the other rail *F*, represented by element *G*, which is earthed, but in addition a resistor *H* in parallel is provided to ensure a current path under abnormal atmospheric conditions. The other contact *C* is similarly connected to a second track relay *J*, in its turn connected to a corresponding insulated rail section *L* which has an impedance represented by element *M* to the earthed rail in parallel with a resistor *N*. Checking relay *K* incorporates a delayed action device and has contacts (not shown) which become closed to indicate a fault when the relay is de-energised for a period greater than the delay imposed by the device. When the contact *B* is closed there will be two current paths to earth from the source through the change-over switch *A*, one directly through the track relay *D* and the other through the checking relay *K* in series with the second track relay *J*. Likewise, when the contact *B* is open and *C* is closed, there will be a direct path through the track relay *J* and another path through the checking relay *K* in series with *D*. As the switch *A* operates, the two track relays are alternately connected directly and indirectly to the current source, whilst the checking relay *K* receives current in both halves of the switching cycle and is only de-energised during those moments in which the switch *A* is in the act of changing over. The characteristics of the relays are such that the current through either track relay, as limited by the impedances and resistances, is insufficient to energise these relays, which are only energised when the passage of a train connects the corresponding insulated rail section directly to the earthed rail *F*. However, the impedance of the checking relay *K* is such that neither track relay can be energised when it is only connected to the current source in series with the checking relay. The track relay can operate, however, when a train is in the corresponding insulated rail section to which the relay is directly connected.—*March* 30, 1960.

EXTRUSION

832,084. January 1, 1958.—EXTRUSION PROCESS, Imperial Chemical Industries, Ltd., Imperial Chemical House, Millbank, London, S.W.1, and Ernest Richard Broadfield, 14, Langford Grove, Harborne, Birmingham, 17, Warwickshire.

According to this invention, there is provided a process for the hot extrusion of metals in which coal tar pitch is employed as a lubricant. The process is particularly suitable for use with aluminium or an alloy of aluminium. The coal tar pitch may contain, as a filler, up to 40 per cent by weight of finely-divided carbonaceous material such as pulverised coal or finely-powdered graphite, to reduce the sensitivity of viscosity to a temperature variation. Conveniently, the pulverised coal is a "low-rank" coal having a high volatile matter content. It has been found that the extrusion of aluminium heated to a temperature within the range 300 deg. to 450 deg. Cent., the use of coal tar pitch, with or without a filler, enables the process to be carried out efficiently, since, in that temperature range, the coal tar pitch is converted into a viscous liquid. Any pitch which adheres to the surface of the extruded aluminium, after it has cooled, may readily be removed therefrom by, for example, burning off.—*April* 6, 1960.

MEASURING INSTRUMENTS

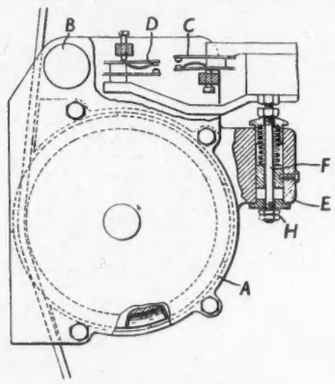
831,752. April 15, 1958.—PNEUMATIC LINEAR DIMENSION GAUGING INSTRUMENTS, Thomas Mercer, Ltd., Eywood Road, St. Albans, Hertfordshire, David James Weatherby, Mount Ash, Mount Avenue, Hutton, Essex, and Harold Roland Crick, 24, St. Audreys Green, Welwyn Garden City, Hertfordshire.

In pneumatic linear dimension gauging instruments the known methods of pneumatic amplification using a pressure sensitive Bourdon tube to register the back pressure changes consequent upon the linear changes in the part being measured usually operate at a magnification factor of between 4000 and 6000 to 1. An object of this invention is to achieve a higher degree of magnification without modification of or restriction in the gauging head. To this end, the conventional circuit is retained as a primary gauging circuit, but movement of the Bourdon tube of the pressure gauge due to changes in back pressure is utilised to obturate a jet in a secondary circuit (in essence a duplicate of the primary circuit) which includes a visual pressure gauge calibrated in suitable linear units. The arrangement illustrated in the specification is such that changes in linear dimension of the workpiece at the gauging head will produce changes in back pressure in the primary circuit downstream of the control orifice of that circuit, which in turn will cause the tip of the Bourdon tube to move an obturating block across the jet of the secondary circuit.—*March* 30, 1960.

ROPE WINDING EQUIPMENT

832,367. December 9, 1957.—WINDING AND HAULAGE EQUIPMENT, The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C.2. (*Inventor: Dennis Surridge Morfey.*)

This invention relates to winding and haulage equipment and has an application in equipment for raising and lowering the control rods of nuclear reactors. It is frequently necessary in equipment of this kind to avoid too large a tension being applied to a rope or cable during unwinding, to prevent continued unwinding of the rope when the tension drops below a minimum value, which may be due, for instance, to a body which is being lowered having reached the limit of its travel or having reached an obstruction. If under such conditions unwinding continues, an excess amount of rope may get entangled. The main object of the invention is to provide improved apparatus for avoiding such conditions. The pulley *A* has a peripheral groove in which runs the winding rope and it is mounted in a carrier which is in the form of a box rotatable about a pivot *B*. In the event of anti-clockwise rotation of the carrier, due to an increase in the tension in the rope, a limit switch *C* is closed by an adjustable rod



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on the carrier. Similarly, when the carrier rotates clockwise, due to a decrease in the tension in the rope, the switch *D* will be closed by a second adjustable rod on the carrier. The periphery of the carrier has an arm *E* through which passes a rod *F* mounted on a fixed support. A spring extends between an abutment member on the rod and a collar secured to the arm. This spring will normally tend to rotate the carrier clockwise about the pivot to oppose the lateral pressure exerted by the rope. This rotation is limited by a stop *H*. When the tension in the rope is released and the lateral pressure is removed, then the limit switch *D* will be closed by the rotation of the carrier about the pivot under the combined action of the weight of the carrier and the force of the spring. Similarly, when the rope tension becomes excessive, the box will be rotated in an anti-clockwise direction, compressing the spring, this movement being limited by the upper face of the arm *E* abutting against the flange on the abutment member. Under these conditions the switch *C* will be closed. If either of the switches is closed, the winding motor is stopped.—*April* 6, 1960.

Catalogues and Brochures

G. BRADY AND CO., Ltd., Ancoats, Manchester, 4.—Folder illustrating rolling shutter and overhead garage doors.

STEDALL MACHINE TOOL COMPANY, 192–204, Pentonville Road, King's Cross, London, N.1.—Machine tool stock list.

J. COLLIS AND SONS, Ltd., Regent Square, Gray's Inn Road, London, W.C.1.—List No. 322, giving details of a range of gravity and power-operated conveyors.

THE MIDLAND HEATING AND VENTILATION COMPANY, Ltd., Bedford Road, Birmingham, 11.—Brochure giving details of low-speed multi-blade centrifugal fans.

INTERNATIONAL RECTIFIER COMPANY (GREAT BRITAIN), Ltd., Oxted, Surrey.—Data sheet SR–2005, containing technical details on "International" selenium rectifier stacks.

ALUMINIUM WIRE AND CABLE COMPANY, Ltd., Port Tennant, Swansea, Glamorgan.—Illustrated brochure describing various stages in the manufacture and erection of seven lengths of A.C.S.R. conductor, each 2¼ miles long and weighing 23 tons, which now form a link in the Central Electricity Generating Board's 275kV Supergrid system across the rivers Severn and Wye as part of a double circuit line connecting Melksham in Wiltshire with Uskmouth in Monmouthshire.

IMPERIAL CHEMICAL INDUSTRIES, Ltd., Metals Division, P.O. Box 216, Birmingham, 6.—"I.C.I. Titanium, Physical and Mechanical Properties," the second booklet in a series on wrought titanium covering properties, corrosion resistance, fabrication and weight tables. Booklet entitled "Wrought Zirconium" containing data on the mechanical and physical properties of zirconium and zirconium alloys and the forms in which they are produced. Information is also included on the associated metal Hafnium.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office not later than a fortnight before the meeting. In all cases the TIME AND PLACE *at which the meeting is to be held should be clearly stated.*

ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS

To-day, May 6.—LIVERPOOL AND DISTRICT BRANCH: Industrial Development Centre, M.A.N.W.E.B., Paradise Street, Liverpool, 1, Films and colour film of the 1959 Electrical Engineers (A.S.E.E.) Exhibition, 7.30 p.m. ★ STOKE AND CREWE BRANCH: Grand Hotel, Hanley, "Fire Alarms," 7.30 p.m.

Mon., May 9.—BOURNEMOUTH AND DISTRICT BRANCH: Grand Hotel, Firvale Road, Bournemouth, Annual General Meeting, 8 p.m. ★ NORTH WEST LONDON BRANCH: Century Hotel, Wembley, "Miniature Circuit Breakers," R. Leach, 8.15 p.m.

Tues., May 10.—CHESTER AND DISTRICT BRANCH: Westminster Hotel, City Road, Chester, "Fluorescent Lighting," 7.45 p.m. ★ GLASGOW BRANCH: Kenilworth Hotel, Queen's Street, Glasgow, C.1, Annual General Meeting, 8 p.m. ★ PORTSMOUTH AND DISTRICT BRANCH: Offices of the Ministry of Labour and National Service, Lake Road, Portsmouth, "Production of a Technical Journal," 7.30 p.m.

Wed., May 11.—BIRMINGHAM BRANCH: Exchange and Engineering Centre, Stephenson Place, Birmingham, 2, "Industrial Lighting," R. J. F. Howard, 7.30 p.m. ★ SOUTH EAST LONDON BRANCH: Eltham Green School, Queenscroft Road, Eltham, London, S.E.9, "Electrical Safety," G. T. Fisher, 7.45 p.m.

Thurs., May 12.—BRADFORD AND DISTRICT BRANCH: Midland Hotel, Bradford, "Variable Speed A.C. Motors," A. Bone, 7.30 p.m.

Sat., May 14.—BIRMINGHAM BRANCH: Visit to Mitchell and Butlers, Ltd., Cape Hill Brewery, Smethwick, Near Birmingham, 9.45 a.m.

BRITISH COMPUTER SOCIETY

Wed., May 11.—BIRMINGHAM BRANCH: Large Theatre, Electrical Engineering Department, The University, Edgbaston, Birmingham, Annual General Meetings of the Branch and of the Midland Region, 6.30 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS

Wed., May 11.—RADAR GROUP: London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1, "Radio Guidance in the Automatic Landing of Aircraft," J. S. Shayler, 6.30 p.m.

Fri., May 20.—STUDENTS' MEETING: London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1, "Servomechanisms and Electronics Engineers—the Present and the Future," M. James, 7 p.m.

Wed., May 25.—Gustav Tuck Theatre, University College, London, Symposium on "Stable Frequency Generation": "The Problem of Frequency Synthesis," H. J. Finden; "The Change-of-State Crystal Oven," D. J. Fewings; "The Application of Counting Techniques to the Control of High Stability H.F. Oscillators," R. P. Thatte; "A Transistorized Frequency Synthesizer," G. Husson and B. N. Sherman; "The Synthesis of High Purity Oscillations Suitable for Single Sideband Receivers," P. S. Carnt and E. Ribchester, and "An Airborne Frequency Generating Unit for the H.F. Communication Band," G. E. Smythe, 3 p.m.

COMBUSTION ENGINEERING ASSOCIATION

Wed., May 11.—SOUTHERN REGION: Great Western Hotel, Station Road, Reading, Discussion on "The Ability of Mechanical Stokers to Comply with Section 1 of the Clean Air Act," 10.30 a.m.

Thurs., May 19.—MIDLAND REGION: Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham, 2 Discussion on "The Automatic Boiler House," opened by M. A. Beechly, 10.15 a.m.

Tues., May 24.—SCOTTISH REGION: Royal Hotel, 5, Union Street, Dundee, Discussion on "Clean Air and Industry," 10.30 a.m., and a Discussion on "Water Treatment for Industrial Boiler Plant," opened by D. S. Kerr, 2 p.m.

ENGINEERING INDUSTRIES ASSOCIATION

Thurs. to Sat., May 12 *to* 14.—2ND NATIONAL CONFERENCE: Royal Hotel, Scarborough, "The Development of Your Business," 9.30 a.m.

ILLUMINATING ENGINEERING SOCIETY

Sun. to Wed., May 15 *to* 18.—SUMMER MEETING: Royal Hall, Harrogate.—*Mon., May* 16: "Progress in the Field of Electric Lamps," H. G. Jenkins, 10 a.m.; "Rationally Recommended Illumination Levels," H. C. Weston, 2.30 p.m.; *Wed., May* 18: "Plastics, Yesterday, To-day and To-morrow," C. L. Child, 10 a.m.

INSTITUTE OF FUEL

To-day, May 6.—SOUTH WALES SECTION: South Wales Institute of Engineers, Park Place, Cardiff, Annual General Meeting, 6 p.m.

Mon., May 23.—Institution of Civil Engineers, Great George Street, London, S.W.1, "Recommendations on Heights for New Industrial Chimneys," G. Nonhebel, 5.30 p.m.

INSTITUTE OF ROAD TRANSPORT ENGINEERS

Fri., May 13.—SOUTH WALES CENTRE: South Wales Institute of Engineers, Park Place, Cardiff, Films, "Cummins Diesels," 7.15 p.m.

Wed., May 18.—EAST MIDLANDS CENTRE: Visit to Pirelli, Ltd., Derby Road, Burton-on-Trent, 2 p.m.

INSTITUTE OF WELDING

Mon. to Wed., May 9 *to* 11.—Spring Meeting at Droitwich.

INSTITUTION OF CIVIL ENGINEERS

Tues., May 17.—Great George Street, Westminster, London, S.W.1, "Port of London Authority—Development of Two Dock Areas, 1959," D. E. Glover, E. Newton, H. M. Dale and T. R. Brown, 5.30 p.m.

Tues., May 24.—Great George Street, Westminster, London, S.W.1, "The New Highway Bridges Across the River Tigris in Iraq at Amara and Kut," W. E. Gelson and G. A. Plank, and "The Analysis of Steel Decks with Special Reference to the Highway Bridges at Amara and Kut, Iraq," B. Farago and W. W. L. Chan, 5.30 p.m.

Thurs., May 26.—Great George Street, Westminster, London, S.W.1, Films, "London to Birmingham Motorway" and "The Changing Face of Lincoln," 5.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS

To-day, May 6.—MEDICAL ELECTRONICS DISCUSSION GROUP: Savoy Place, London, W.C.2, Discussion on "Methods of Recording Measurements—Digital or Analogue," opened by W. J. Perkins, 6 p.m.

Sat., May 7.—LONDON GRADUATE AND STUDENT SECTION: Visit to National Physical Laboratory, Teddington, 10 a.m.

Mon., May 9.—SOUTH MIDLAND CENTRE: College of Technology, Gosta Green, Birmingham, "Radio Aspects of the International Geophysical Year," R. L. Smith-Rose, 6.30 p.m.

Wed., May 11.—SUPPLY SECTION: Savoy Place, London, W.C.2, "The Development of the 400kV Network in Sweden," G. Jancke, 5.30 p.m.

Thurs., May 12.—ORDINARY MEETING: Savoy Place, London, W.C.2, "The Resistance of Sheet Insulation to Surface Discharges," J. H. Mason, 5.30 p.m.

Mon., May 16.—NORTH STAFFORDSHIRE SUB-CENTRE: Technical College, Stafford, Annual General Meeting, and "The Characteristics and Protection of Semiconductor Rectifiers," D. B. Corbyn and N. L. Potter, 7 p.m. ★ LONDON GRADUATE AND STUDENT SECTION: Savoy Place, London, W.C.2, Annual General Meeting, and Films, 6.30 p.m.

Wed., May 18.—SHEFFIELD SUB-CENTRE: Grand Hotel, Sheffield, Annual General Meeting, and "The Design of Housing-Estate Distribution Systems using a Digital Computer," R. L. Grimsdale and P. H. Sinclare, 6.30 p.m.

Thurs., May 19.—LONDON SECTION: Savoy Place, London, W.C.2, Annual General Meeting, and "Technical Features of a New Television Studio at Wembley," A. M. Spooner, 5.30 p.m.

Fri. to Mon., May 20 *to* 23.—WESTERN CENTRE: Abernant Lake Hotel, Llanwrtyd Wells, Summer Meeting.

INSTITUTION OF ENGINEERING DESIGNERS

Wed., May 18.—YORKSHIRE BRANCH: Midland Hotel, Bradford, "Plastics," 7.30 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS

Fri., May 27.—Institution of Mechanical Engineers, 1, Birdcage Walk, Westminster, London, S.W.1, Joint Meeting with the Aluminium Development Association, Symposium on "The Use of Aluminium in Railway Rolling Stock," 10 a.m. and 2.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS

To-day, May 6.—WESTERN BRANCH: The Duke of Cornwall Hotel, Millbay Road, Plymouth, Meeting with the Institution of Structural Engineers, "The Jodrell Bank Radio Telescope," H. C. Husband, and Film, "The Inquisitive Giant," 6 p.m.

Sat., May 7.—SOUTHERN BRANCH: Visit to the site of the Proton Synchrotron at the Rutherford High Energy Laboratory, Harwell, 2 p.m. ★ WESTERN BRANCH: Visit to Hinkley Point Nuclear Power Station, Bridgwater, Somerset, 10.30 a.m.

Tues., May 10.—SOUTHERN GRADUATES' SECTION: South Dorset Technical College, Newstead Road, Weymouth, "The Dragon Reactor Experiment," G. E. Lockett, 7.30 p.m.

Wed., May 11.—SOUTHERN BRANCH: Visit to Chatham Dockyard, 2 p.m.

Mon., May 16.—MIDLAND GRADUATES' SECTION: Engineering Centre, Stephenson Place, Birmingham, Visit of Mr. K. H. Platt: Talk and Discussion, 7 p.m.

Thurs., May 19.—SOUTHERN BRANCH: Visit to the factories of Welworthy, Ltd., in the Lymington and Ringwood areas, 4 p.m.

Tues., May 24.—LONDON GRADUATES' SECTION: 1, Birdcage Walk, Westminster, London, S.W.1, Annual General Meeting, and "Lotus, the Design and Development," B. A. Luff, 6.30 p.m. ★ MIDLAND GRADUATES' SECTION: Evening visit to Stewarts and Lloyds, Ltd., Erdington, Birmingham.

INSTITUTION OF MINING AND METALLURGY

Thurs., May 19.—Geological Society, Burlington House, Piccadilly, London, W.1, Annual General Meeting, 4 p.m.

INSTITUTION OF PLANT ENGINEERS

Tues., May 10.—MANCHESTER BRANCH: Engineers' Club, Albert Square, Manchester, "The Application of New Materials to Plant Engineering," J. Leyland, 7.15 p.m.

Thurs., May 12.—GLASGOW BRANCH: Scottish Building Centre, 425/427, Sauchiehall Street, Glasgow, "Industrial Television and its Applications," S. G. Gobbi, 7.15 p.m. ★ NORTH-EAST BRANCH: Roadway House, Oxford Street, Newcastle upon Tyne, "Science and Industry," E. Martindale, 7 p.m.

Sat., May 14.—WESTERN BRANCH: Visit to British Railways, Swindon Works, 10.30 a.m.

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS

Mon. to Wed., May 23 *to* 25.—Winter Garden, Eastbourne, Sussex, Annual Delegate Conference.

JUNIOR INSTITUTION OF ENGINEERS

To-day, May 6.—ORDINARY MEETING: Pepys House, 14, Rochester Row, Westminster, London, S.W.1, "Standardisation of Some Electrical Measuring Instruments," F. W. L. Bosch; to be read by W. J. Hart, 7 p.m.

PLASTICS INSTITUTE

Wed., May 11.—SOUTH WALES AND MONMOUTHSHIRE SECTION: Angel Hotel, Cardiff, Annual General Meeting, 6.30 p.m.

Fri. to Sun., May 20 *to* 22.—Institute Visit to the Midlands Section.

ROYAL COLLEGE OF SCIENCE AND TECHNOLOGY

Tues. to Fri., May 17 *to* 20.—Department of Mechanical, Civil and Chemical Engineering, Glasgow, C.1, Symposium on "Nuclear Reactor Containment Buildings and Pressure Vessels."

ROYAL METEOROLOGICAL SOCIETY

Wed., May 18.—49, Cromwell Road, London, S.W.7, "A Theory of Fronts in Relation to Surface Stress," F. K. Ball; "An Experimental System for Directly Recording Statistics of the Intensity of Atmospheric Turbulence," J. I. P. Jones and F. Pasquill, and "The Reflection of Short-Wave Radiation by Vegetation," J. L. Monteith, 5 p.m.

ROYAL SOCIETY OF ARTS

Mon., May 9.—CANTOR LECTURE: John Adam Street, Adelphi, London, W.C.2, "Energy—The Generation of Power," J. M. Kay, 6 p.m.

Mon., May 16.—CANTOR LECTURE: John Adam Street, Adelphi, London, W.C.2, "Energy—The Transmission of Power," F. H. S. Brown, 6 p.m.

Mon., May 23.—CANTOR LECTURE: John Adam Street, Adelphi, London, W.C.2, "Energy—The Retail Distribution of Electricity," C. Robertson King, 6 p.m.

ROYAL SOCIETY

Thurs., May 12.—Burlington House, Piccadilly, London, W.1, "An Analysis of Rock Magnetic Data," P. M. S. Blackett, J. A. Clegg and P. H. S. Stubbs, and "The Origin of the Solar System," W. H. McCrea, 4.30 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY

Wed., May 11.—DATA PROCESSING SECTION: Manson House, 26, Portland Place, London, W.1, Annual General Meeting, and "A Recording Stereocomparator," A. E. Adams, 6.15 p.m.

SOUTH WALES INSTITUTE OF ENGINEERS

Thurs., May 19.—Institute Buildings, Park Place, Cardiff, "The Aberthaw Power Station," W. Wilde, 6 p.m.

TELEVISION SOCIETY

Fri., May 13.—The Cinematograph Exhibitors' Association Theatre, 3rd Floor, 164, Shaftesbury Avenue, London, W.C.2, "The Status of Storage Tubes in America," R. R. Law, 7 p.m.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE

Fri., May 13.—39, Elmbank Crescent, Glasgow, C.2, All-day conference on "Internal Defects in Steel and Methods of their Assessment," 10 a.m.

WOMEN'S ENGINEERING SOCIETY

Wed., May 18.—LONDON BRANCH: "Hope House," 45, Great Peter Street, Westminster, London, S.W.1, "Electronic Weighing," Miss R. Winslade, 7 p.m.

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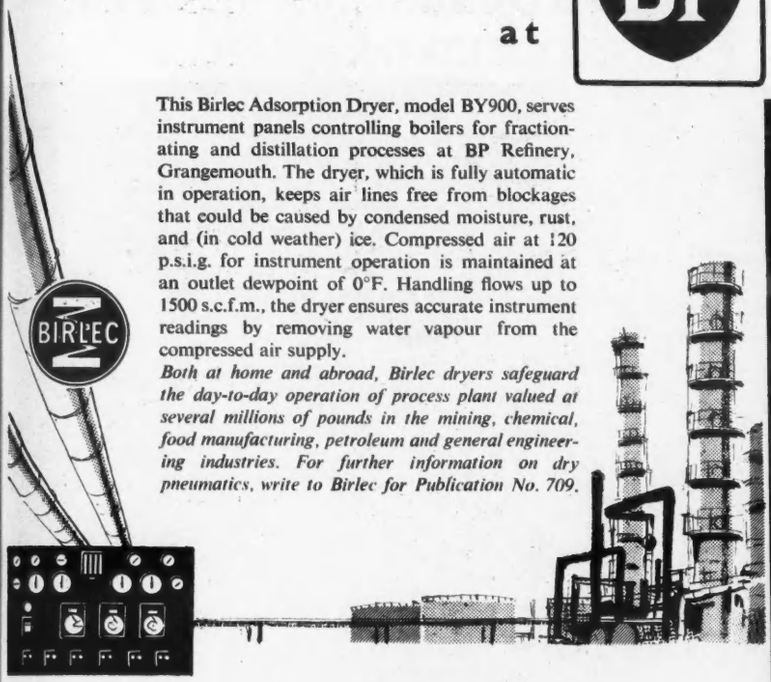

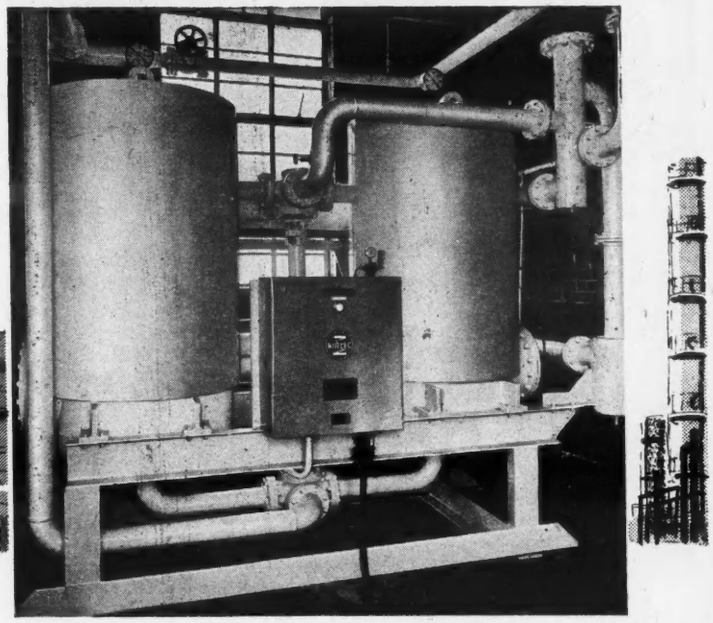

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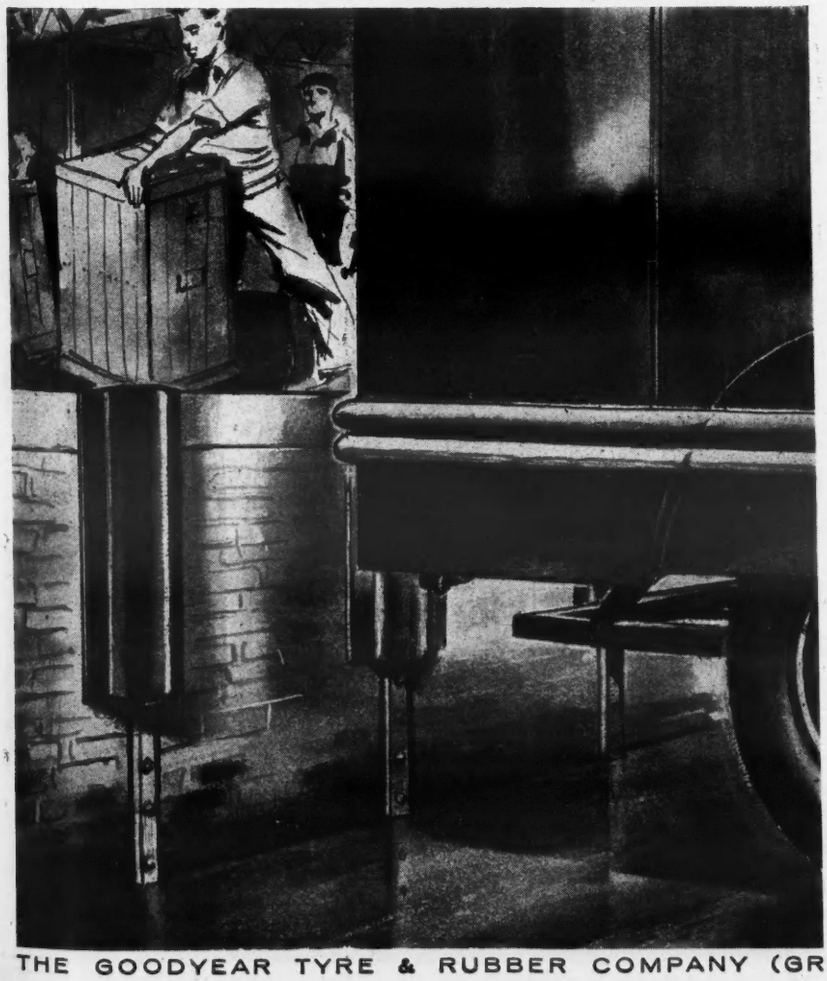

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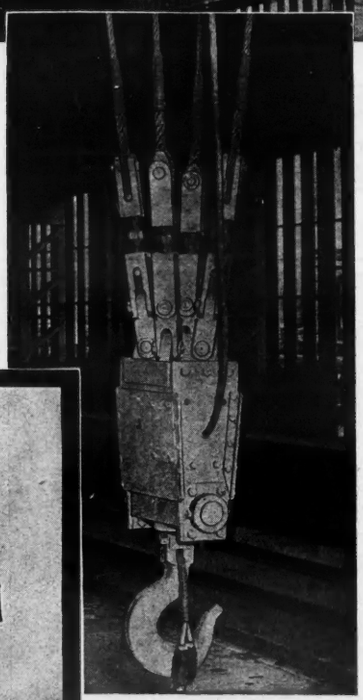
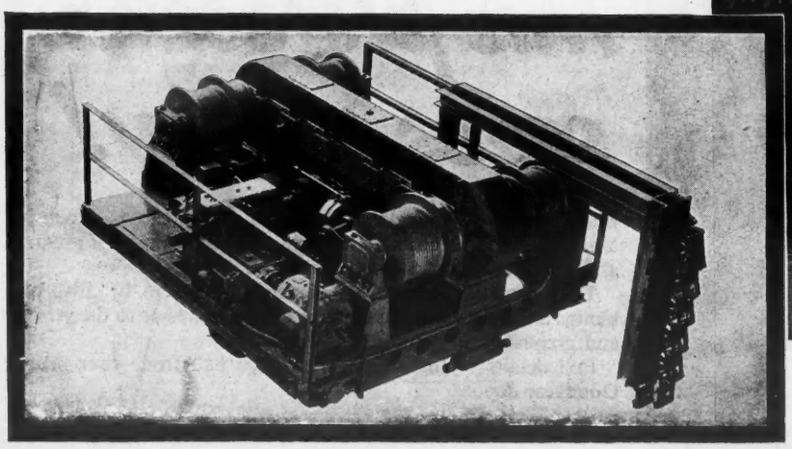
(RIGHT) The hook with slip-ring gear for the magnet, showing attachment of the four ropes.
(BELOW) The special four barrel crab.





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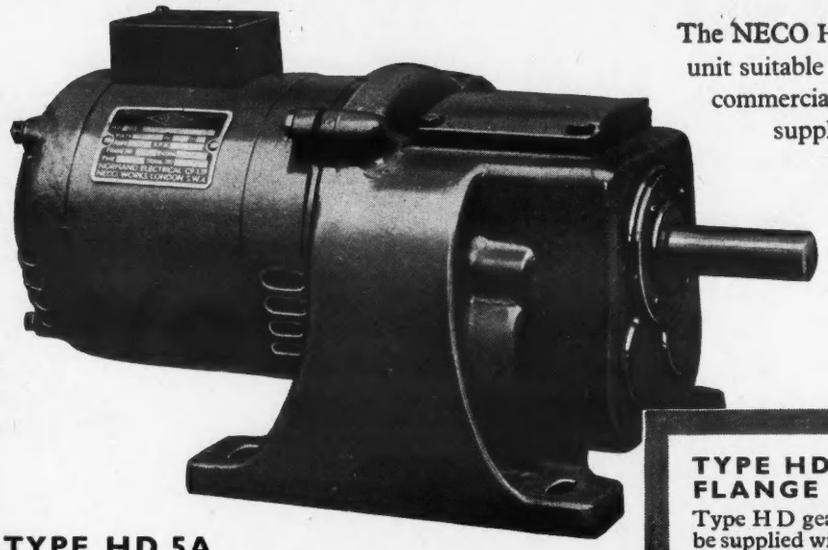
type H D geared motors



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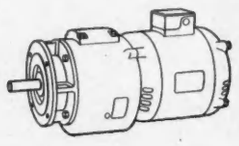

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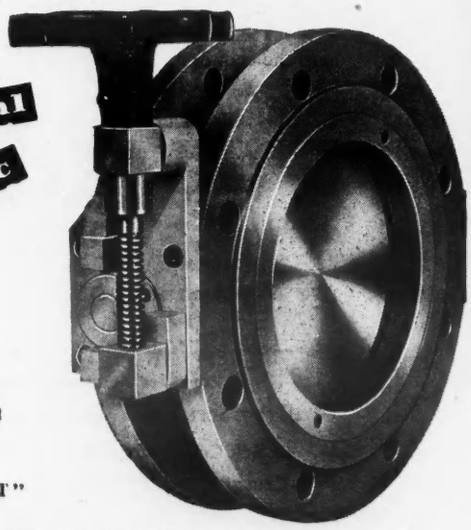

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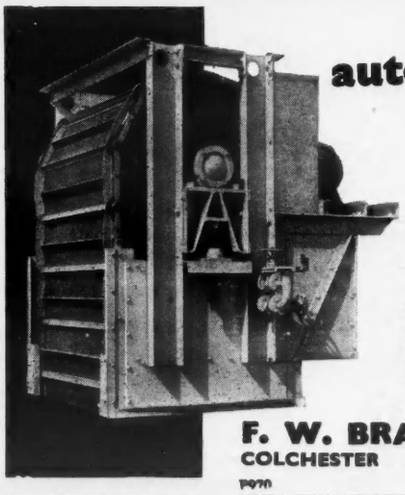

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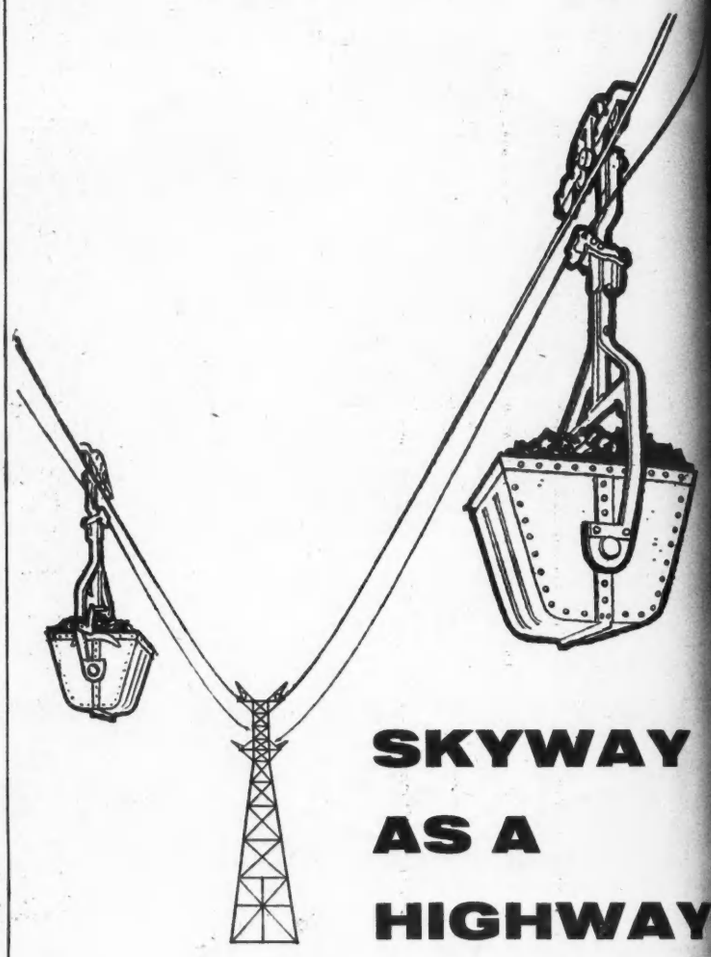

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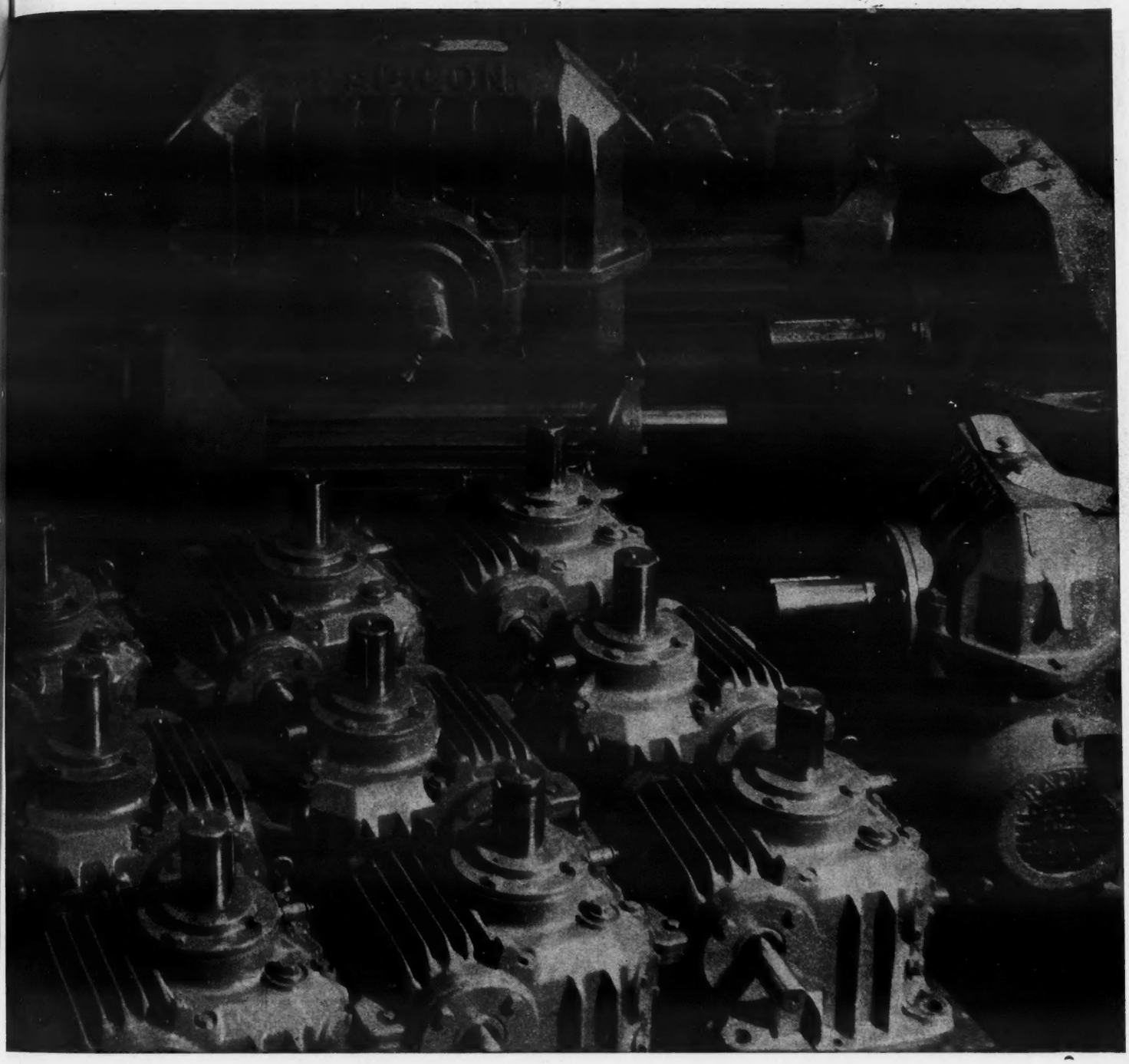

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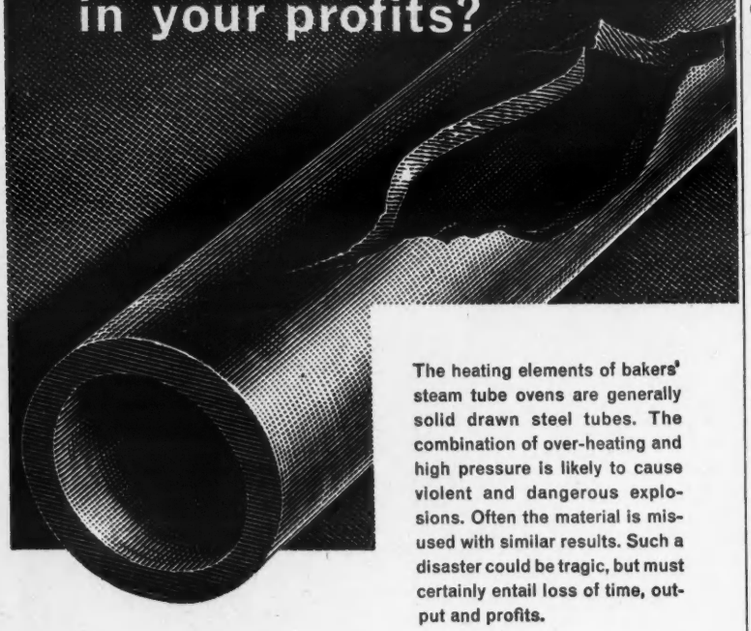

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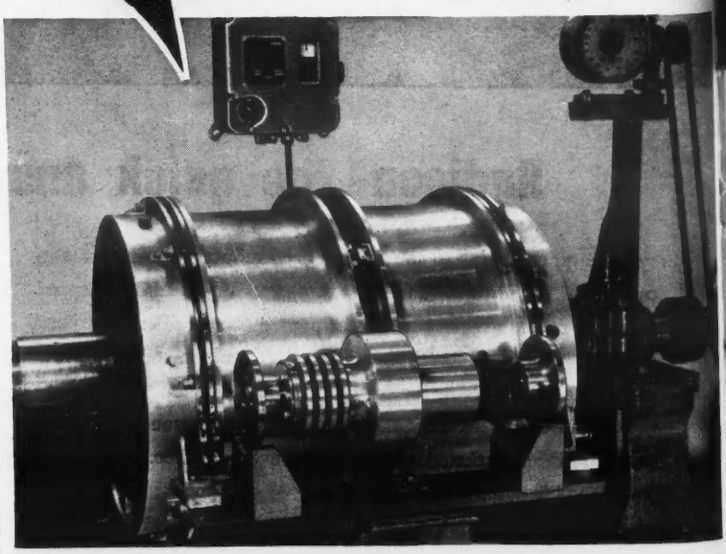

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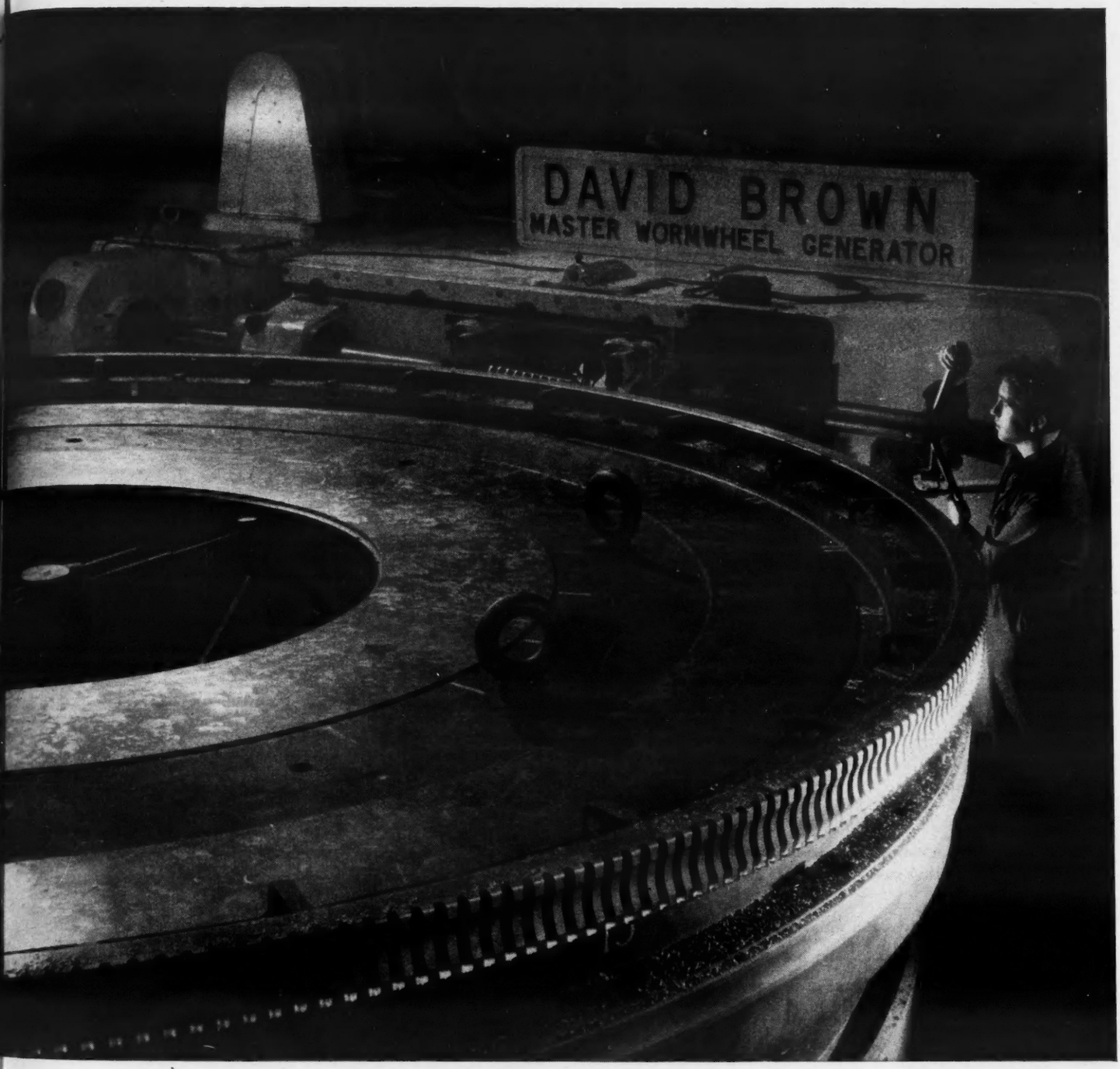

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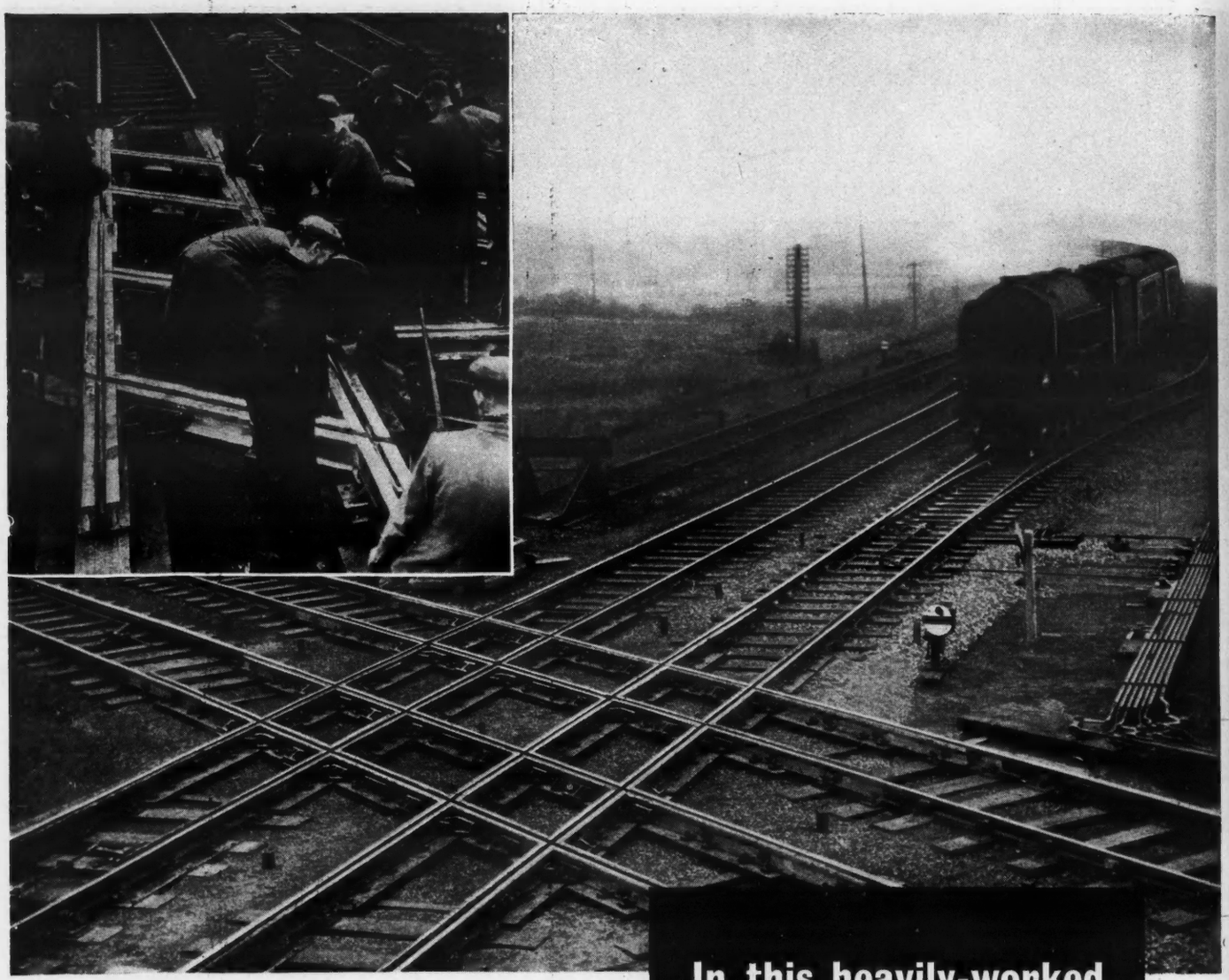

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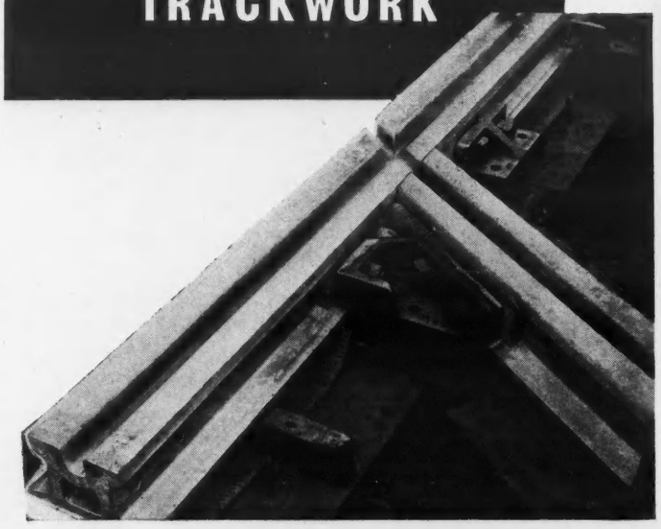

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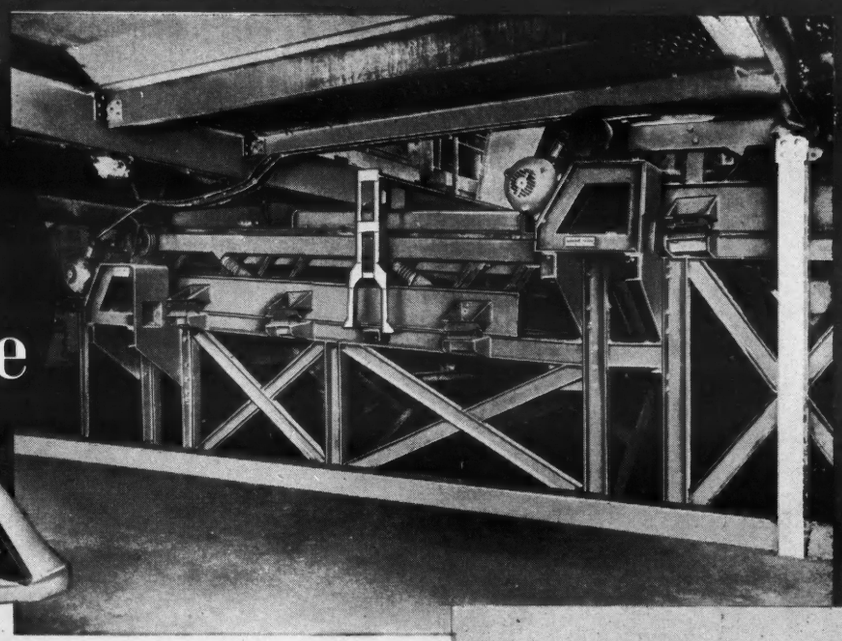

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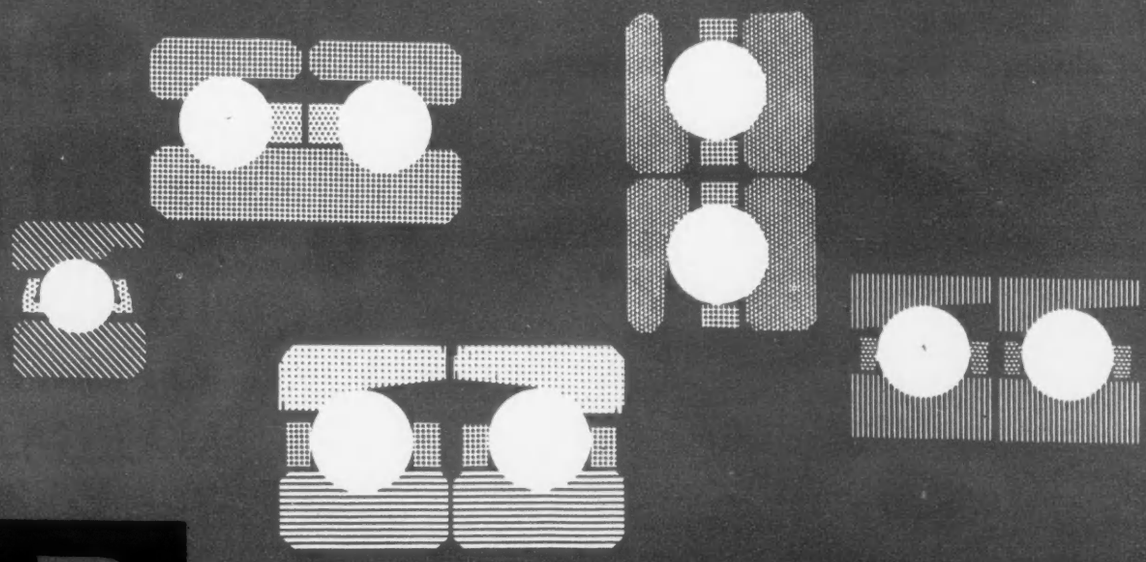

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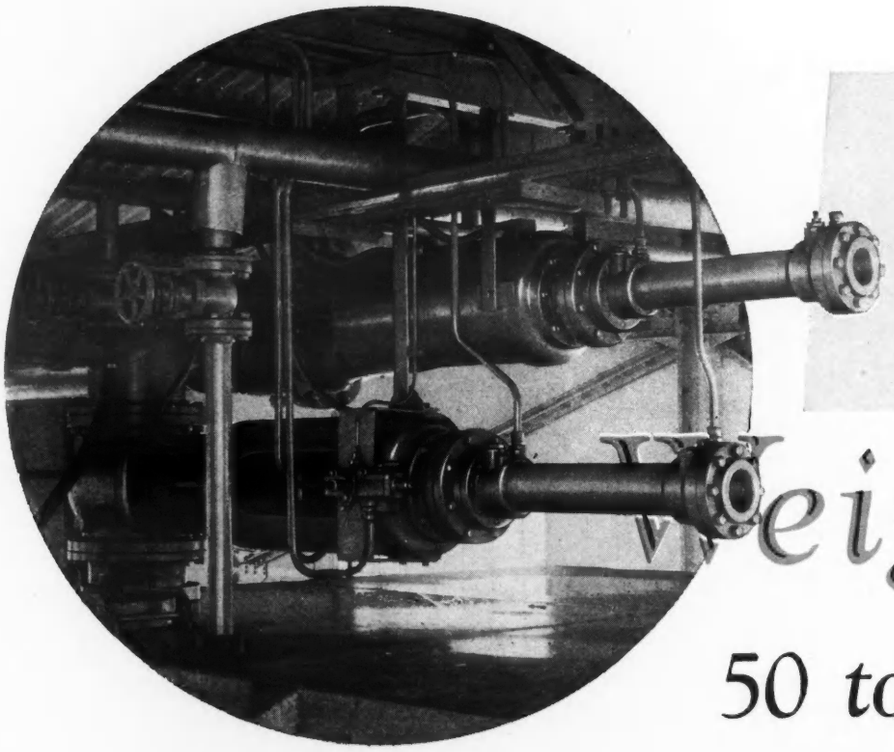

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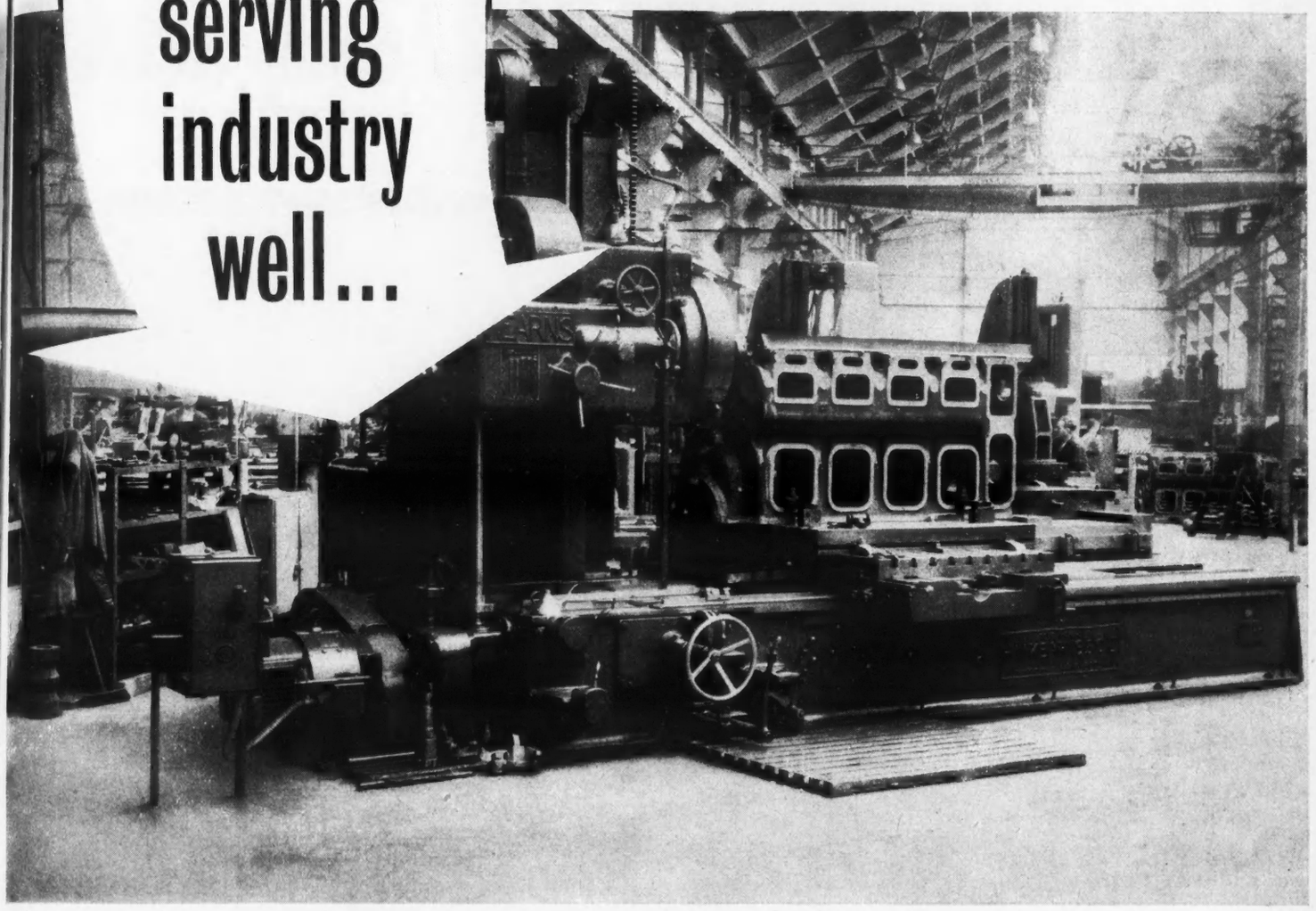

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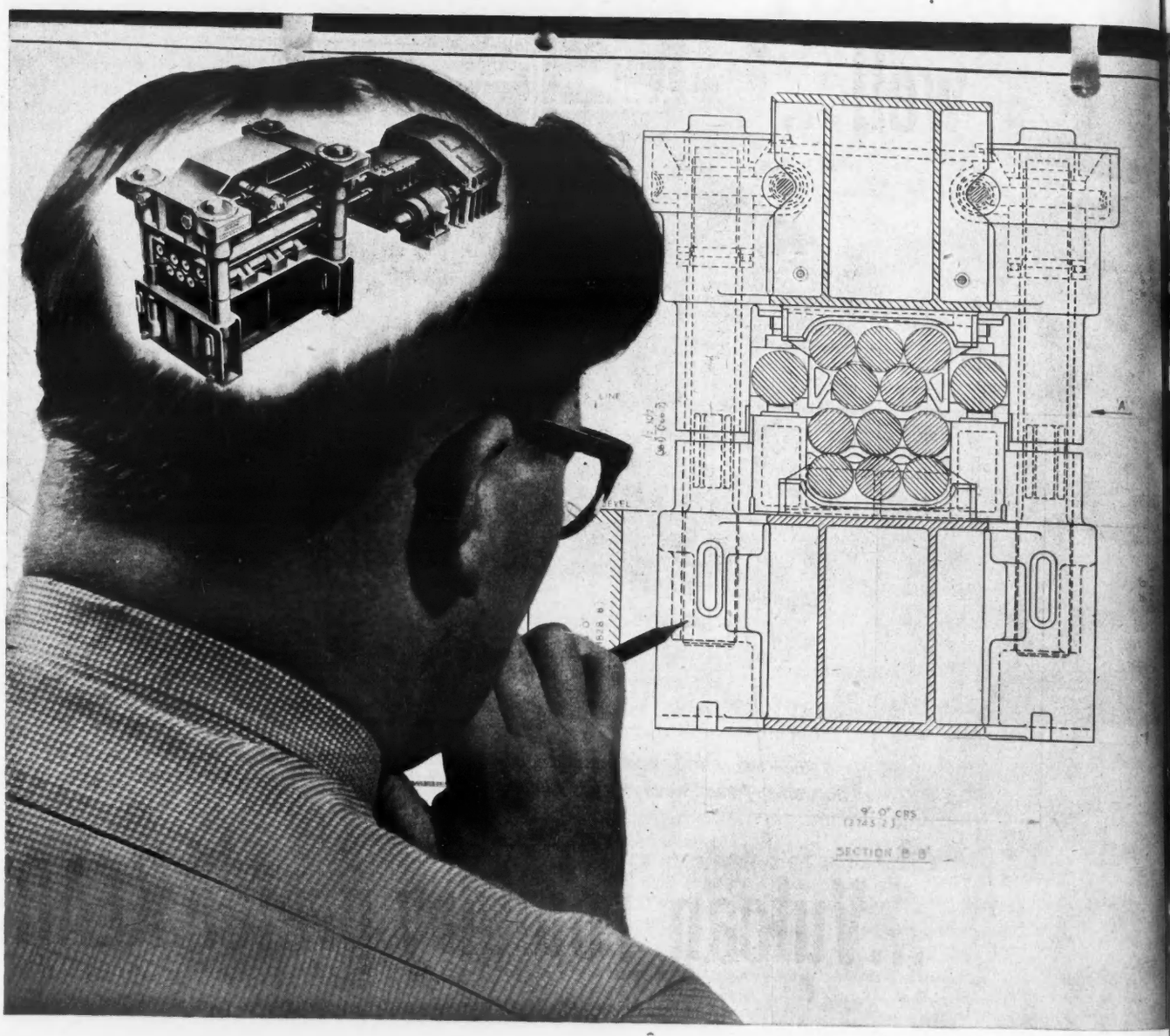

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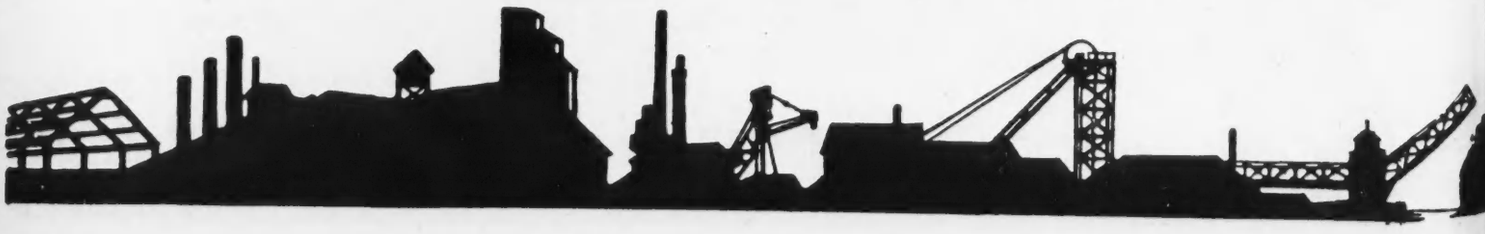

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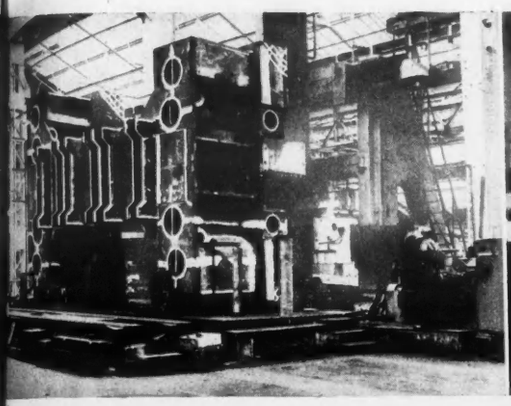
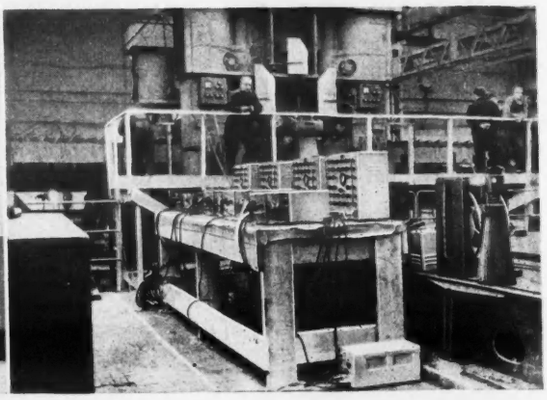
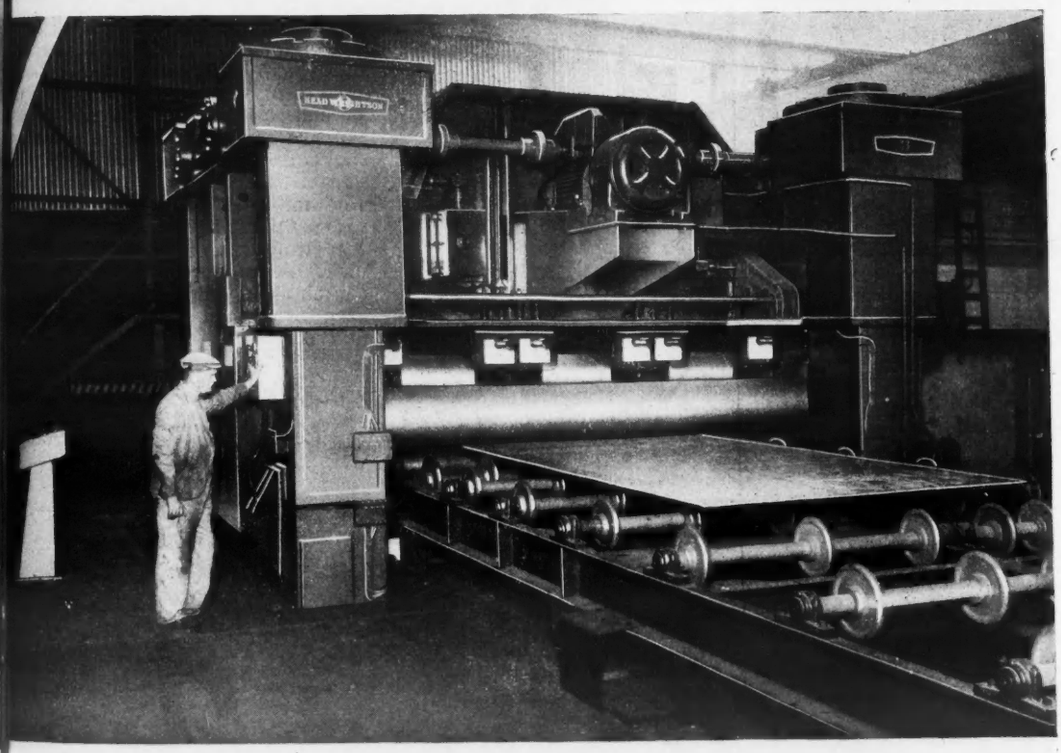




(Left) Leveller beam being machined.

(Right) The leveller undergoing fully instrumented tests prior to installation. Tests carried out with the assistance of the Group Research and Development Division.

(Below) The finished leveller installed and in operation.



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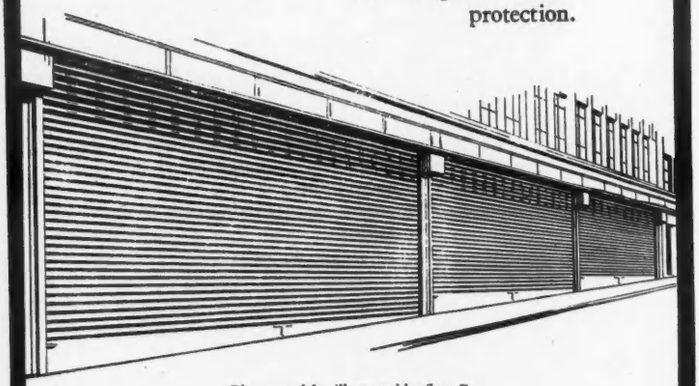

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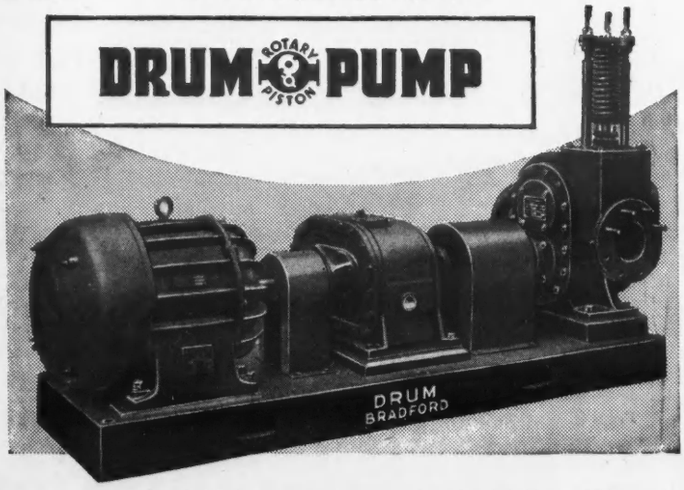

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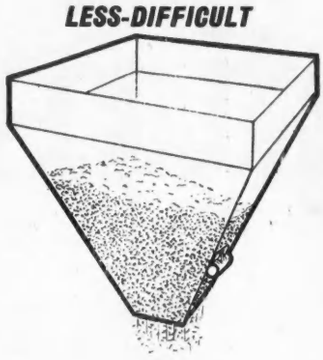
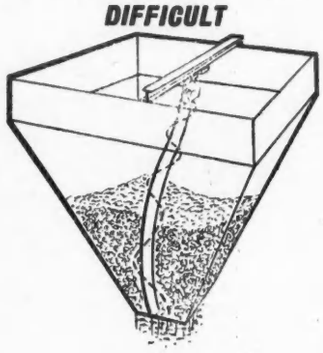


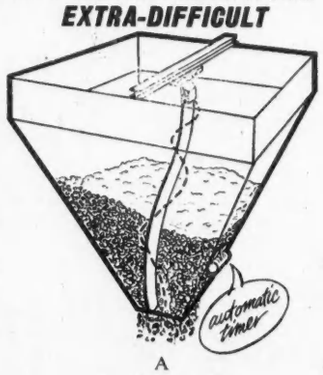
The installation of an external vibrator to a steel hopper.

DIFFICULT



The vibrating reed for application where external vibration is impractical due to structural or other difficulties and if the bunker is made of concrete.

EXTRA-DIFFICULT



A combination of internal and external bunker vibration. Where the external vibrator is timed for 'on and off', the vibration frequency, on slowing down, goes through the natural resonance of the bunker, irrespective of load material contained.

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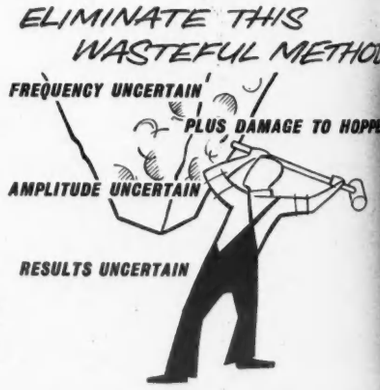

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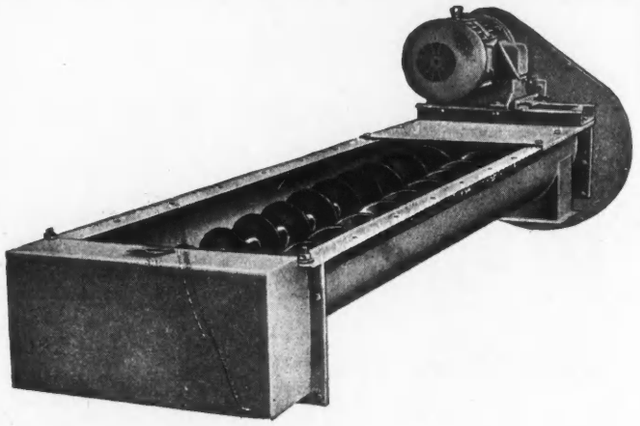

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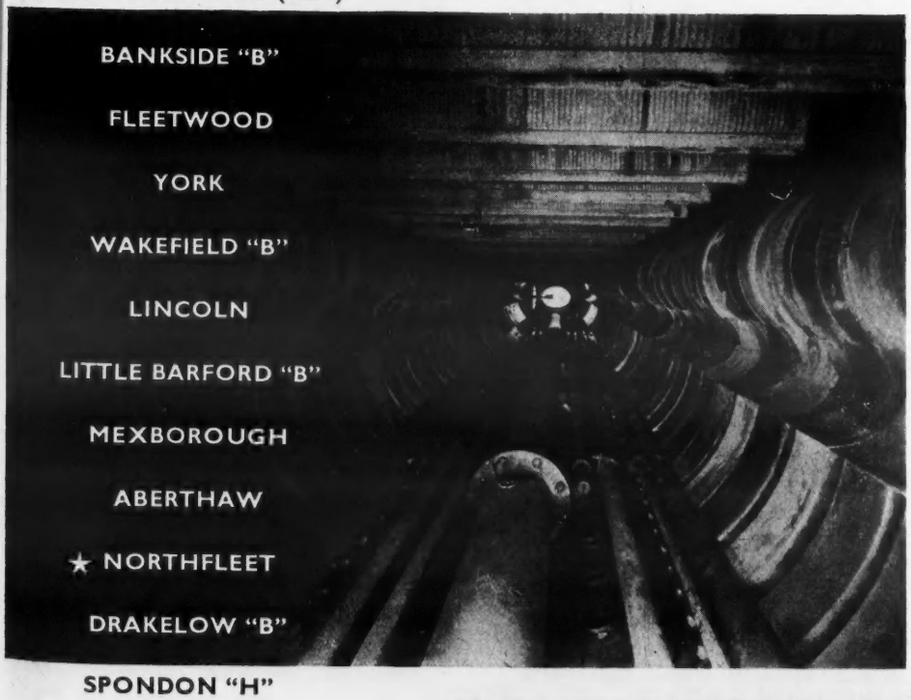

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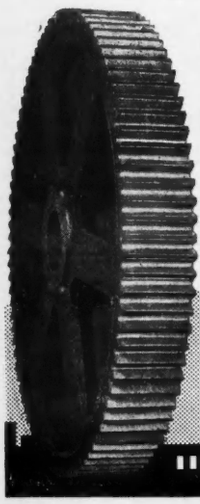

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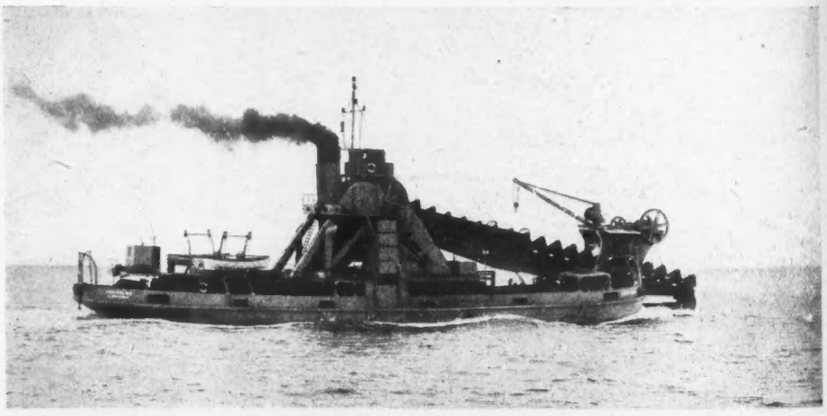

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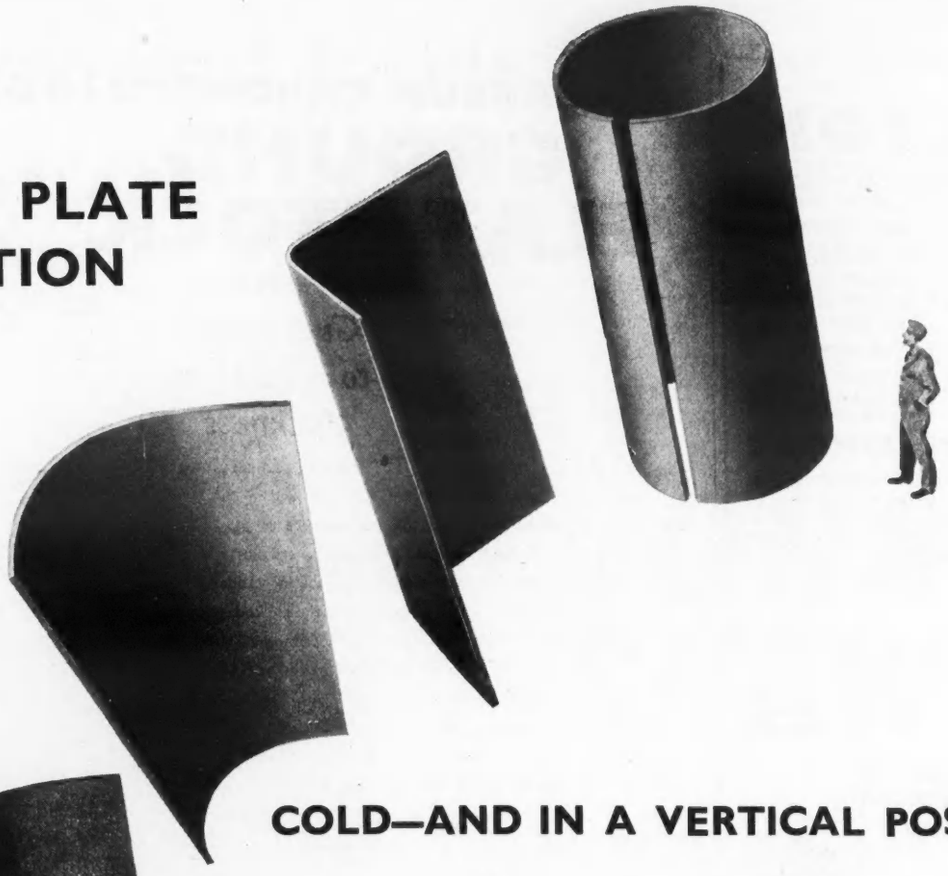

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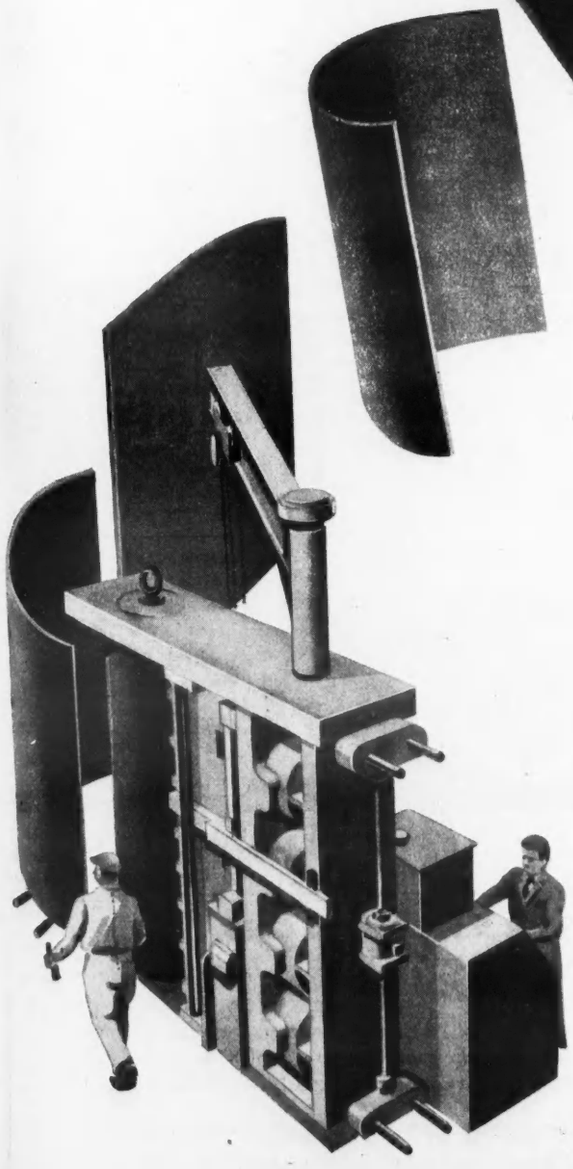

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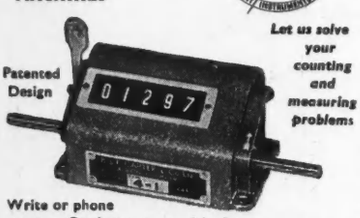

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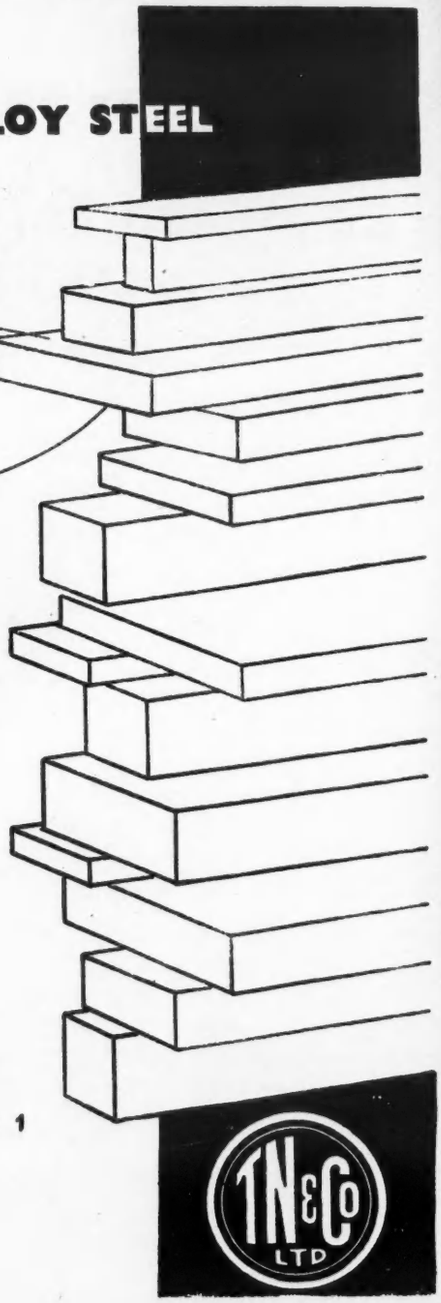

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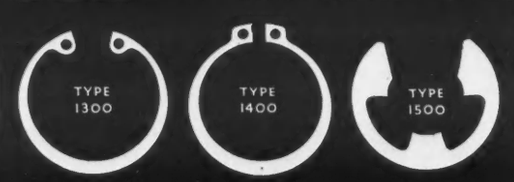

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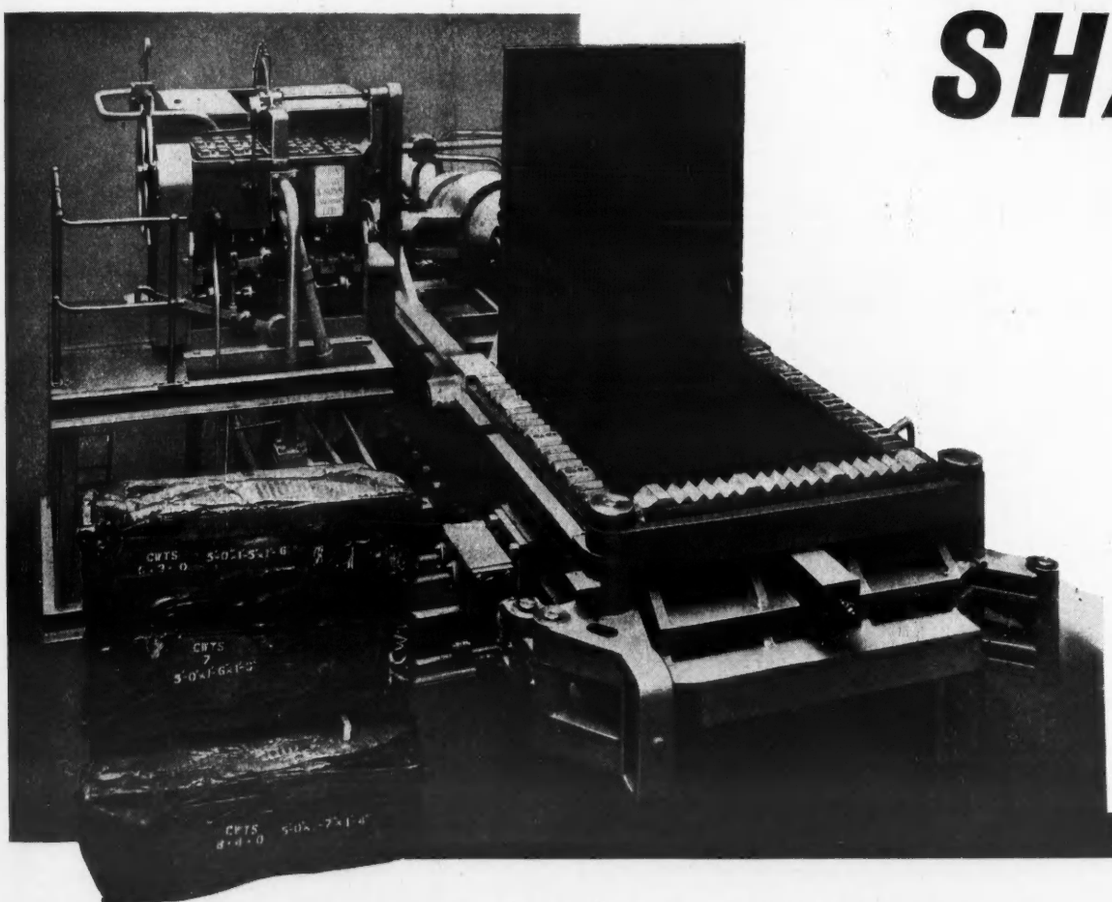

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All these and many others are described and illustrated in Catalogue No. 59 which we have recently produced.

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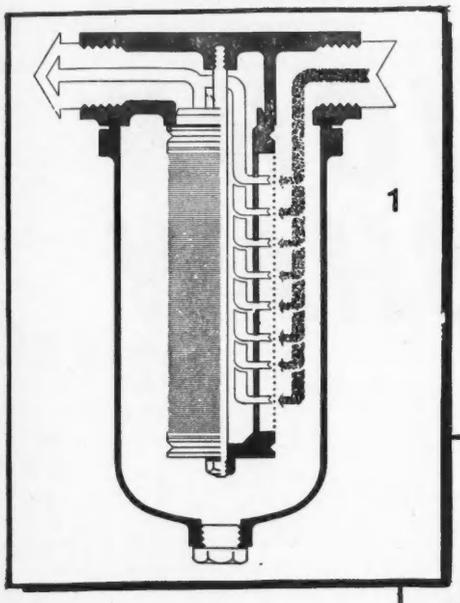
INSIDE INFORMATION

ON MODERN FILTRATION TECHNIQUES



AUTO-KLEAN LOLOS (1)

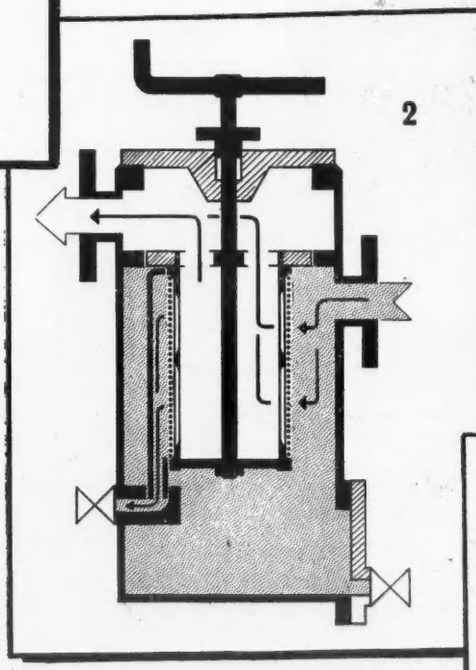
This is a range of filters incorporating wire-wound elements designed for ultra fine filtration of low to medium viscosity fluids under pressure.

Principle: A ribbed cylindrical former is screw cut, and a continuous monel or stainless steel wire is tightly wound into the grooves. By altering the pitch and/or the diameter of the wire defined alterations of mesh can be accomplished. LOLOS L.F. filters have a fabric sleeve fitted over a fine mesh wire-wound element.

Advantages: AUTO-KLEAN LOLOS filters ensure ultra fine filtration *with negligible pressure loss.* Their robust construction remains non-collapsible under extreme pressures, requiring practically no maintenance. Also important is its small lightweight construction.

Data: Working pressures can be arranged up to 2,000 lb/sq.in. Also included in the range are duplex and multi-element designs.

Typical Applications: Hydraulics; fuel and lubrication systems in air, sea and land transport, cooling circuits; distilleries; irrigation lines; washing and bottling plants, etc.



AUTO-KLEAN FLUSHFLO (2)

This is a range of self-cleaning filters specifically designed for continuous operation in the cooling and lubricating systems of heavy machinery.

Principle: Sludge collected by a wire-wound element is dislodged by reverse flow, while the filter element is electrically or manually turned. In contact with the wire element is a spring-loaded slotted tube which acts simultaneously as 'scraper' and discharge passage.

Advantages: The FLUSHFLO is completely self-cleaning while in service without interruption of liquid flow. It ensures fine, positive full-flow filtration with very low pressure losses. And, because the sludge is removed automatically without dismantling, its use leads to reduced maintenance costs. FLUSHFLO filters are also noted for their large capacities relative to size.

Data: Capacities and mesh dimensions fully tabulated in Auto-Klean literature. Quotations on request for processes and capacities not already covered.

Typical Applications: Large scale oil and water cooling circuits; hydraulics; washing plants; water treatment plants; machine lubrication, etc.

AUTO-KLEAN MICOM (3)

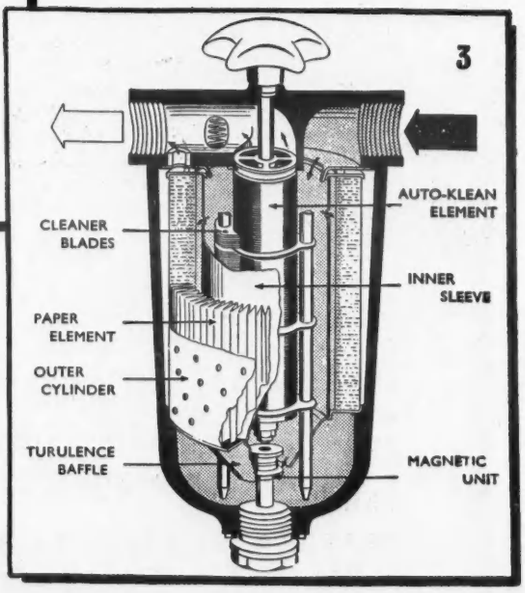
The MICOM combines the advantages of paper as a clarifier with the efficient characteristics of an Auto-Klean, self-cleaning, plate-type element in a full flow filter.

Principle: The greater part of the fluid passes through the plate-type element, while the remainder is filtered by the paper. *The whole of the filtered liquid passes to the outlet side of filter,* thereby giving the maximum protection to the system. A magnetic unit is also incorporated as additional protection against micronic ferrous particles.

Advantages: Positive filtration is guaranteed despite build-up on paper element; paper cannot collapse through choking and therefore its lifetime is increased; constant pressure is maintained as build-up on paper increases . . . while the plate-type filter can be automatically cleaned by turn of the handle—without dismantling. Also important is the low pressure loss and small, lightweight construction of the MICOM.

Data: Working pressures up to 50 lb./sq.in. Can be supplied with ratchet gear for link drive from moving mechanism.

Typical Applications: Ideal for diesel engine lubrication systems of the medium horse-power range and other similar recirculatory applications.



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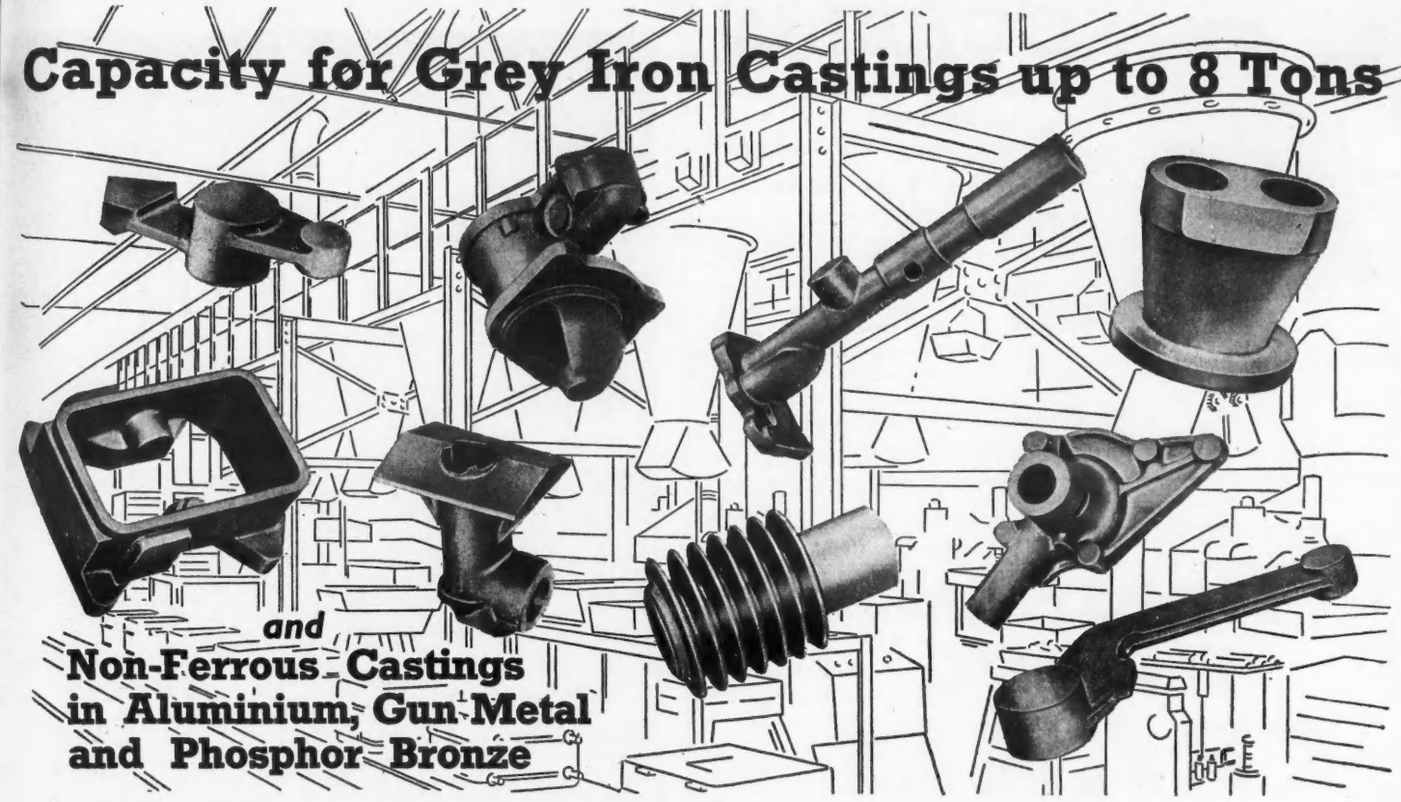

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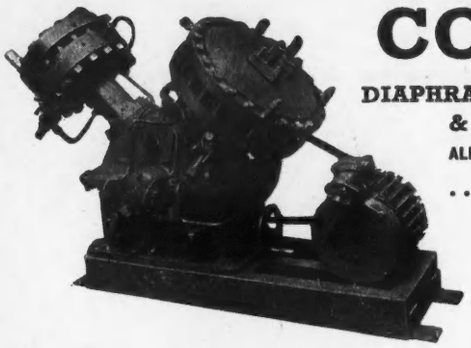

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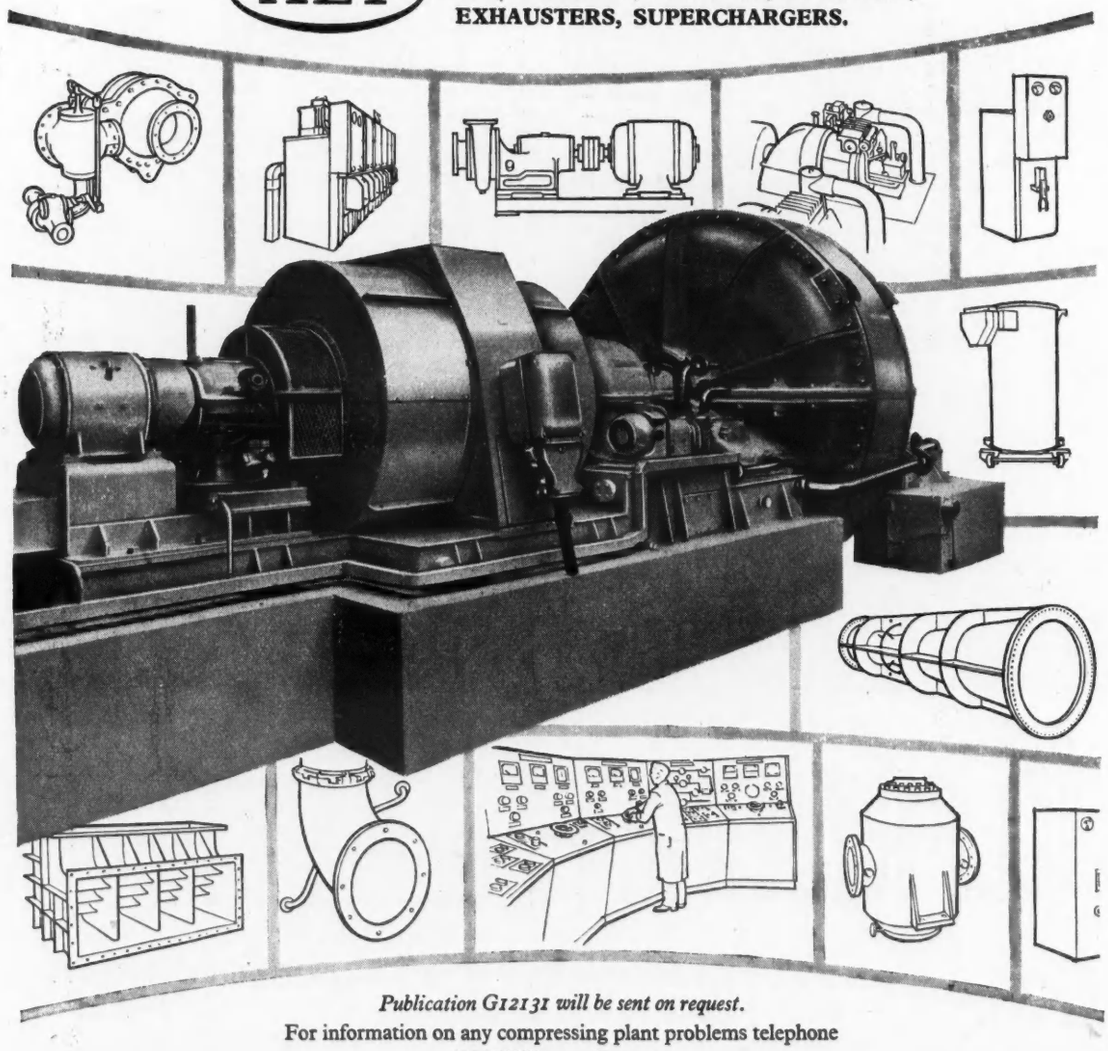

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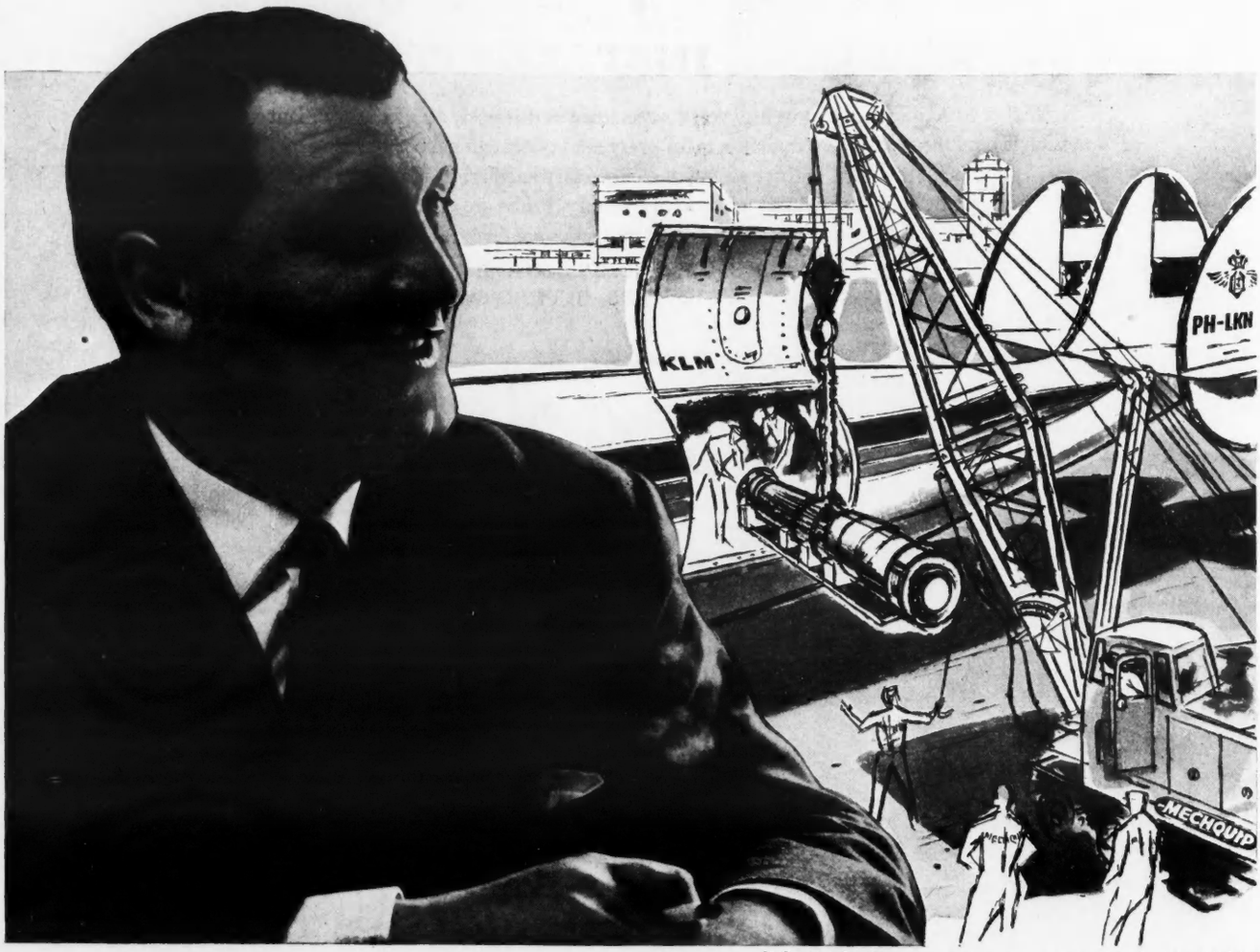

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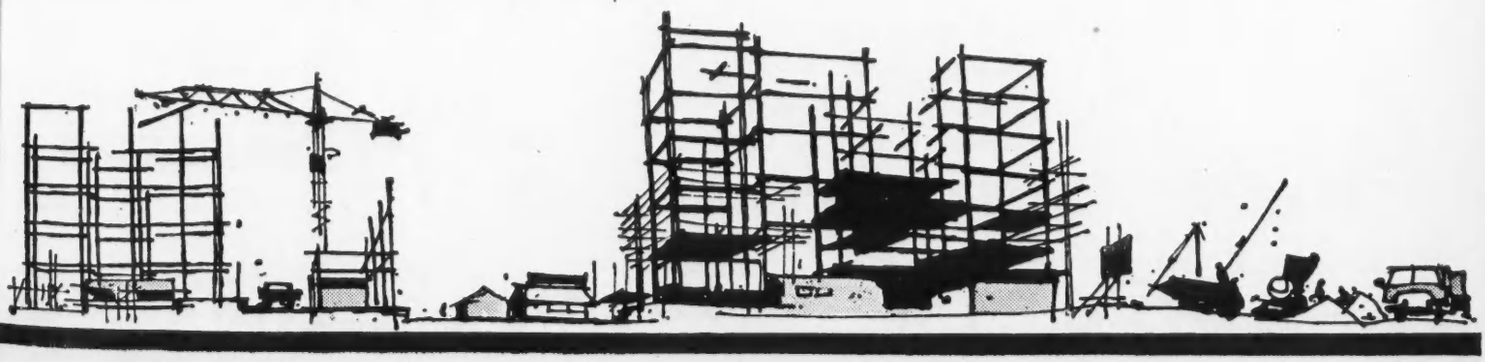

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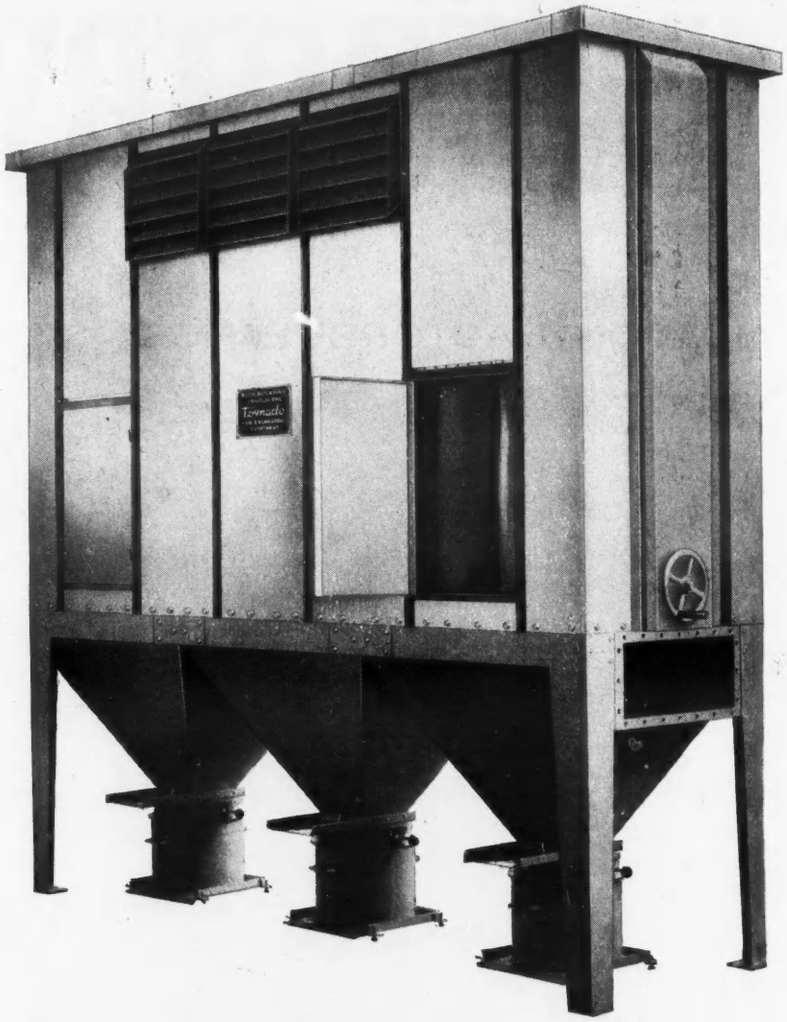

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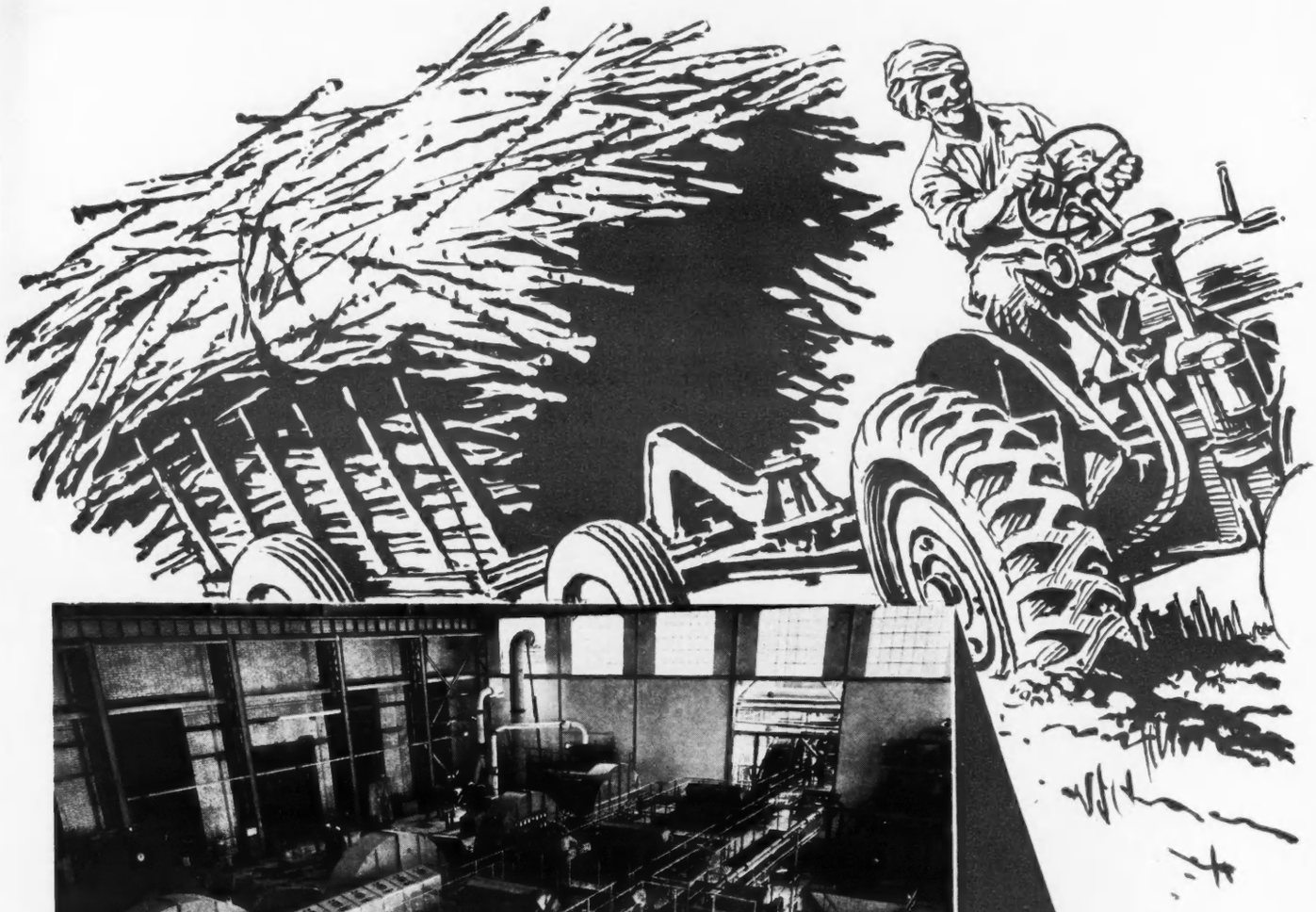

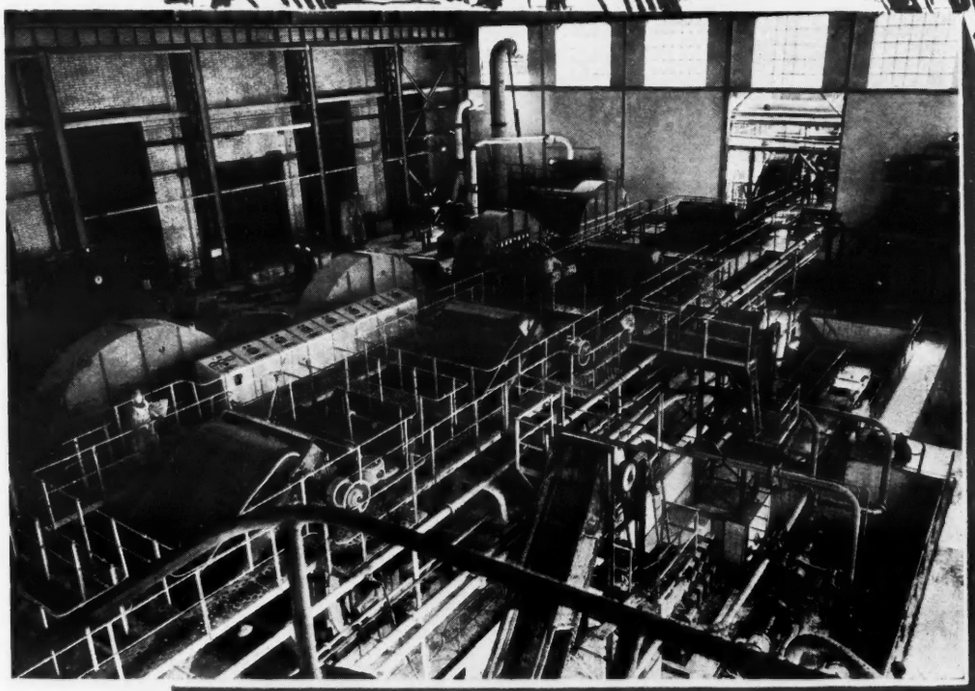

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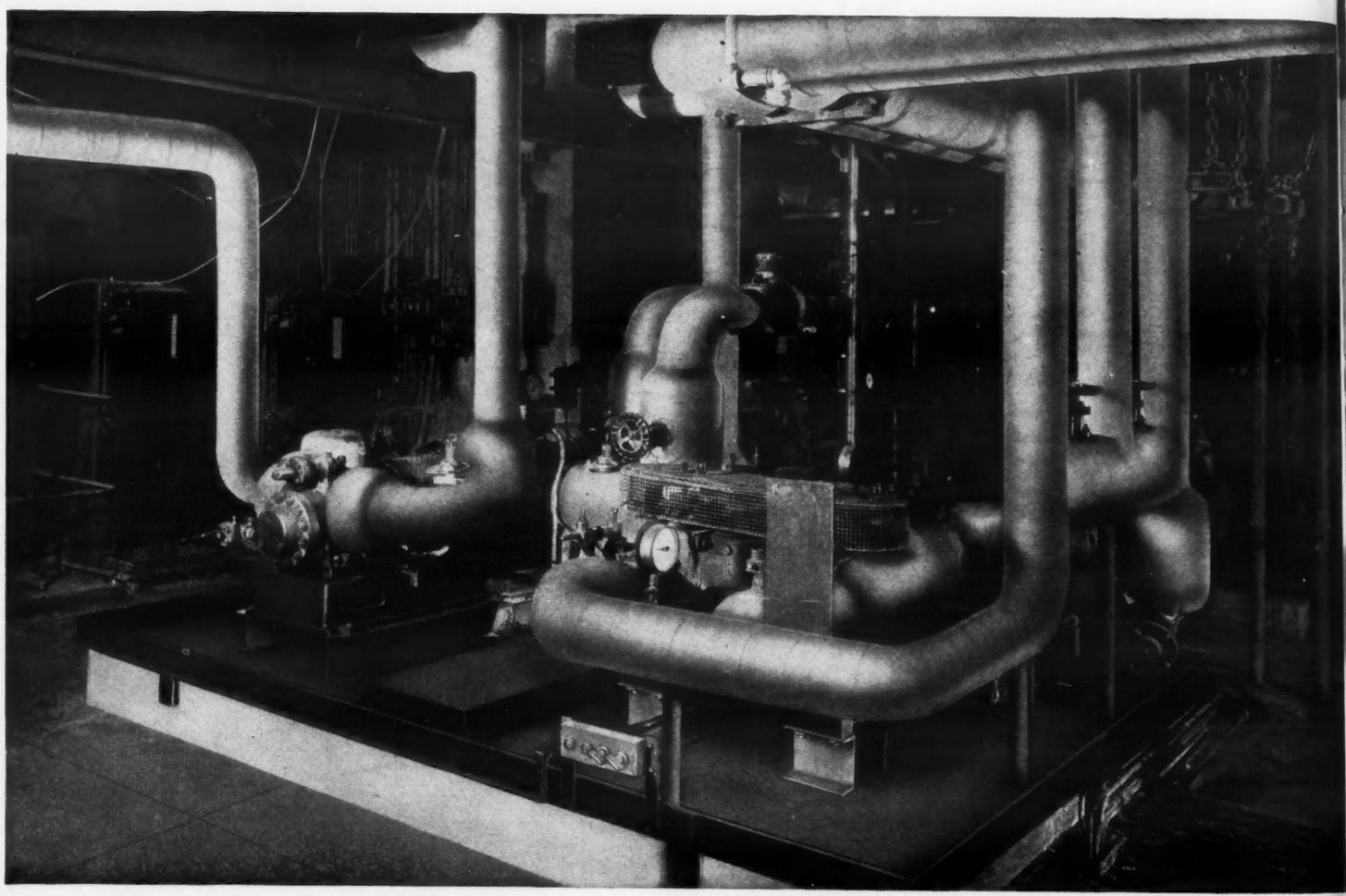

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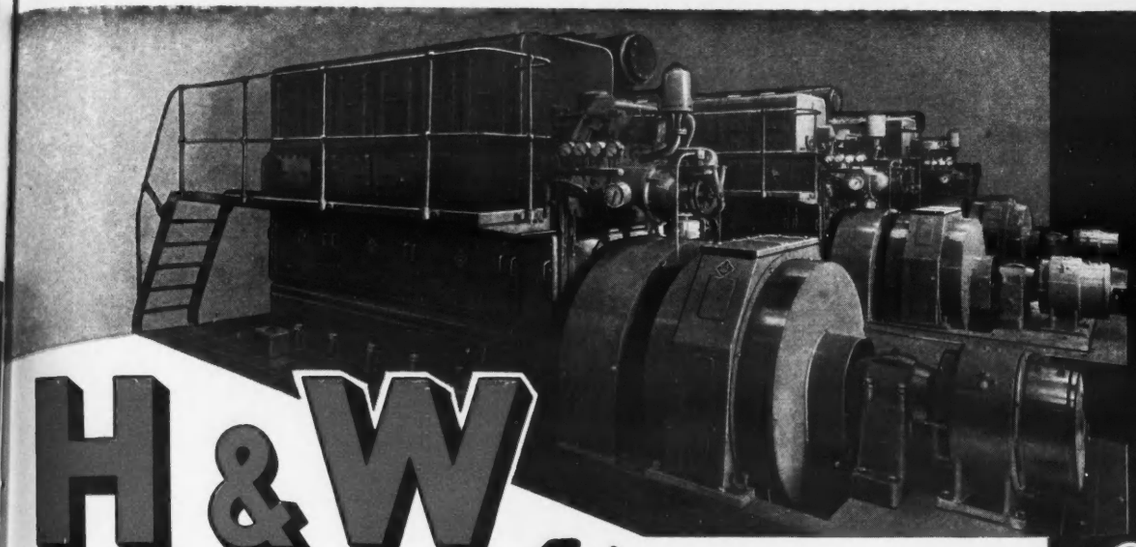

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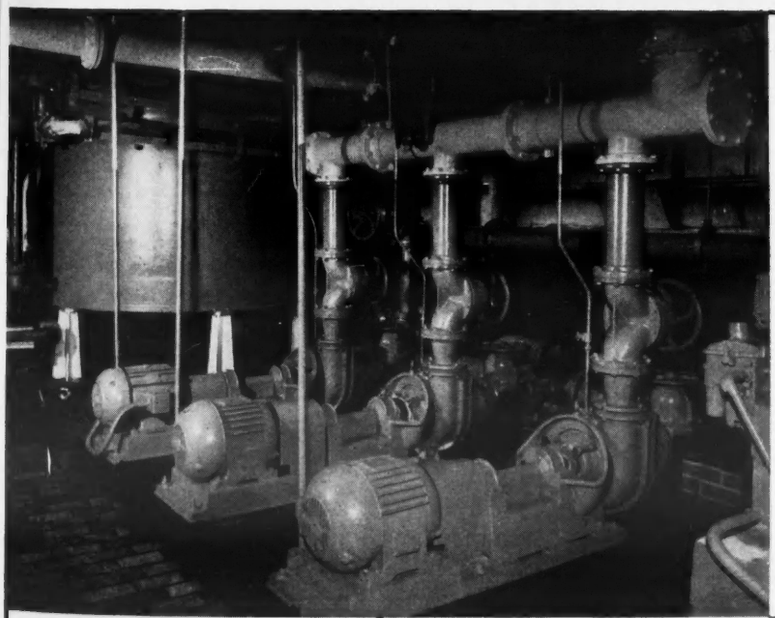

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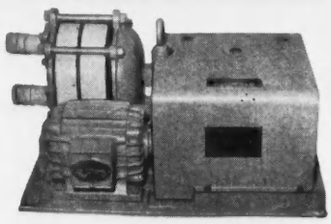
(Bottom left) Close-up view of diaphragm pump similar to the hand operated unit but arranged for motor drive
(Bottom centre) Hand operated portable diaphragm pump for emptying carboys or tanks and for general duties.
(Bottom right) Portable rotary displacement pump pumping plating solutions in the motor car trade



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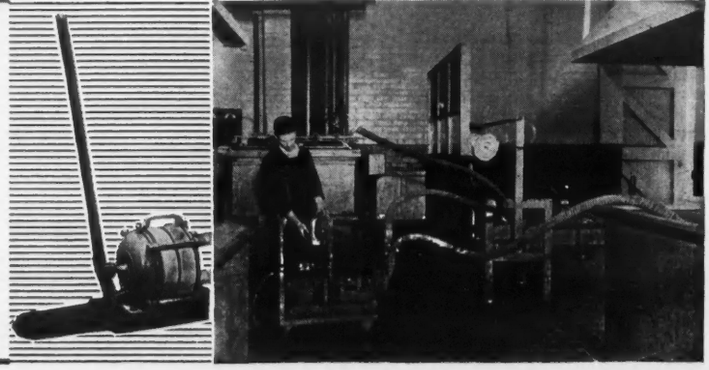

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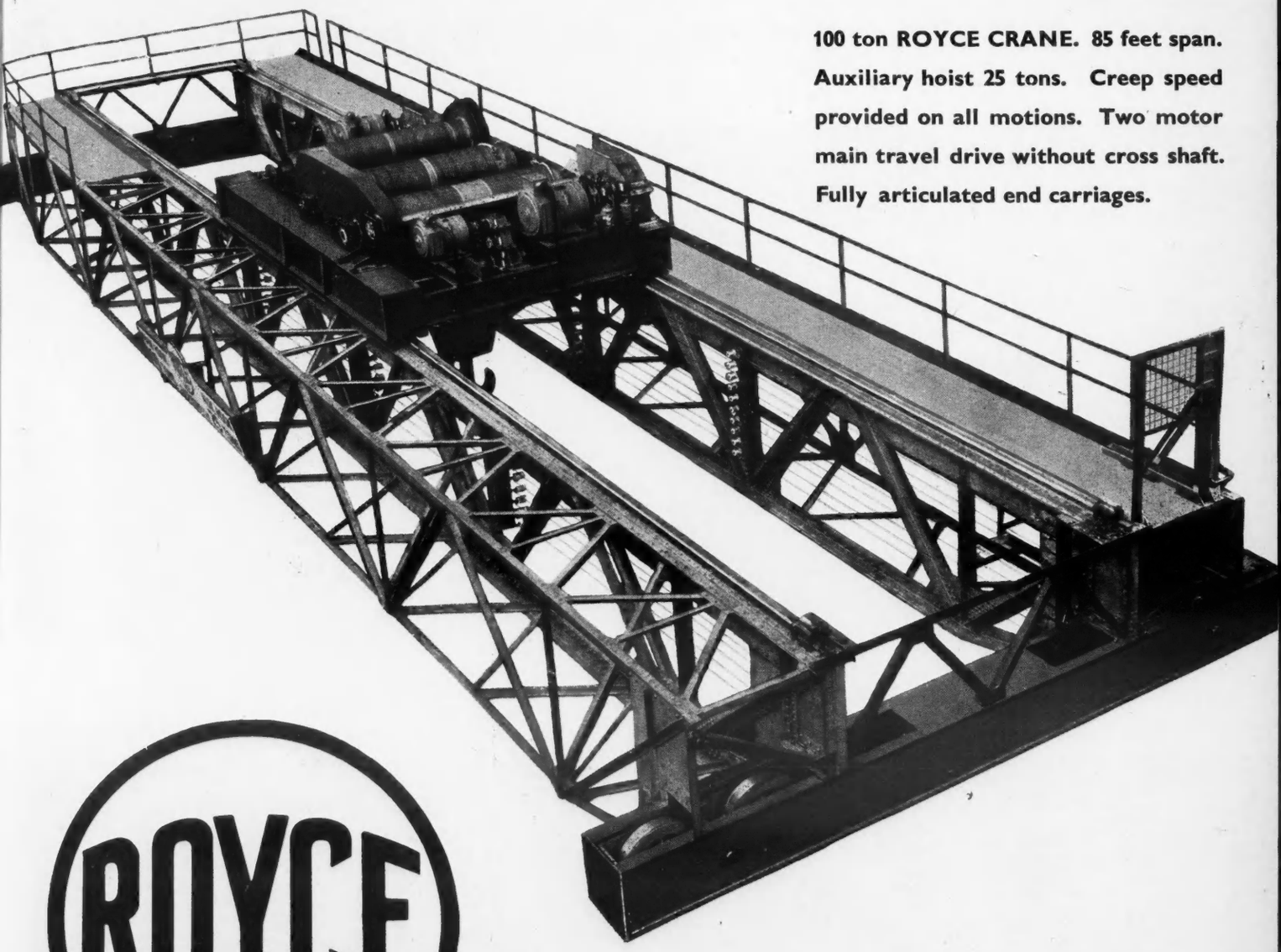

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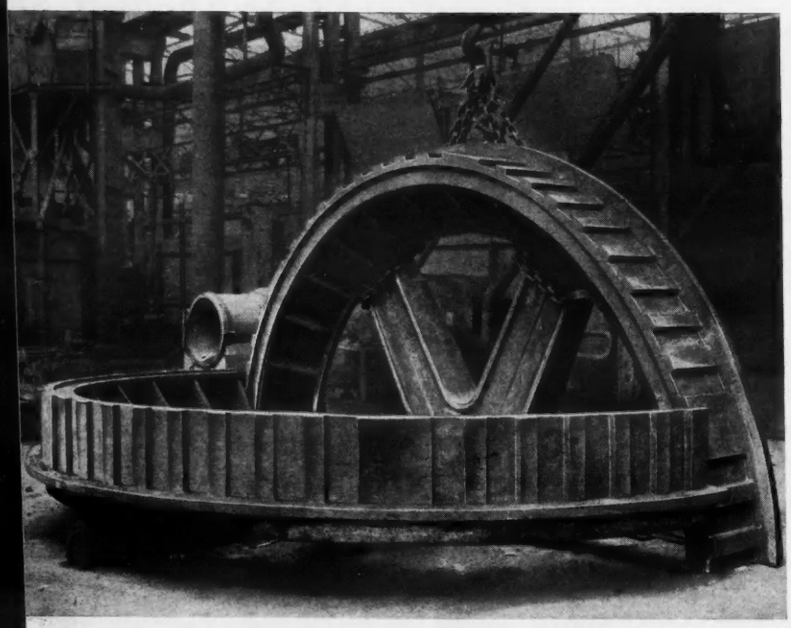
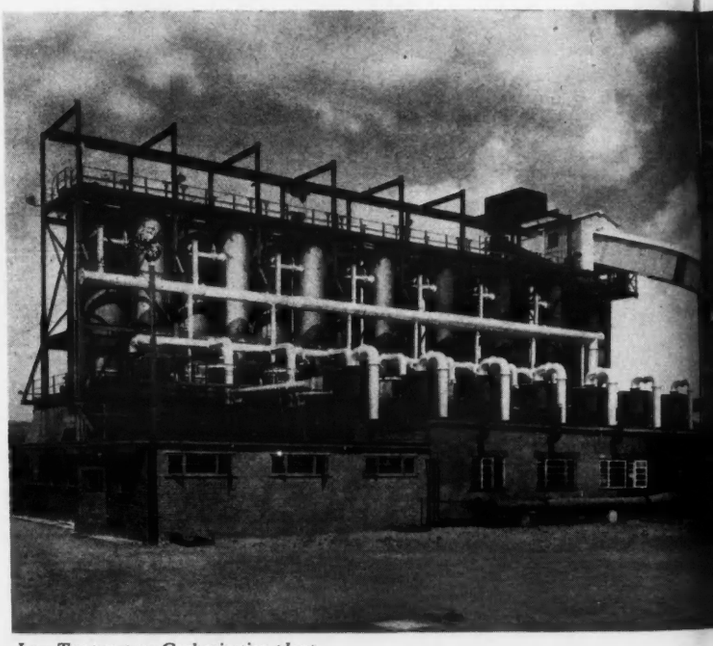


Large castings in Meehanite metal



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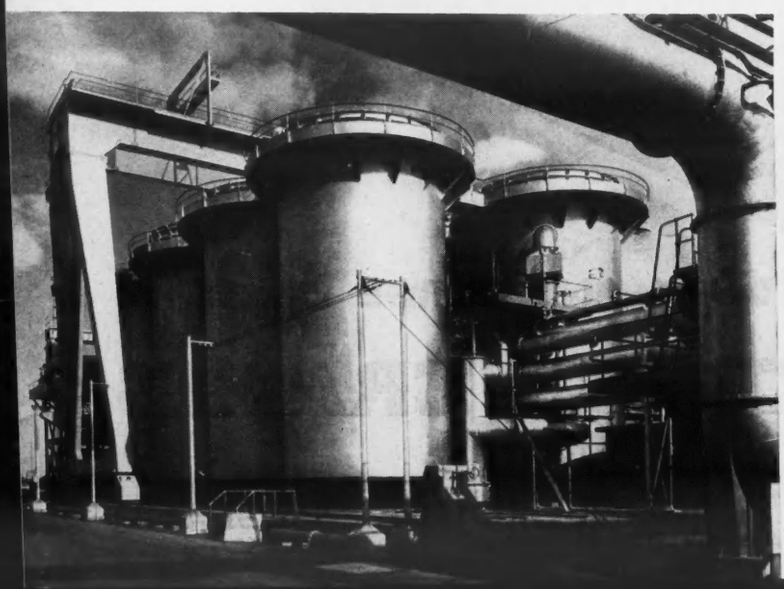
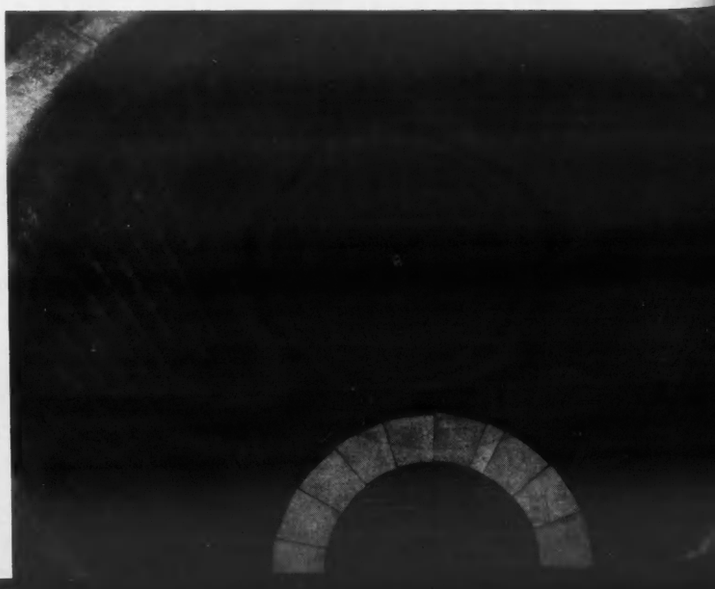
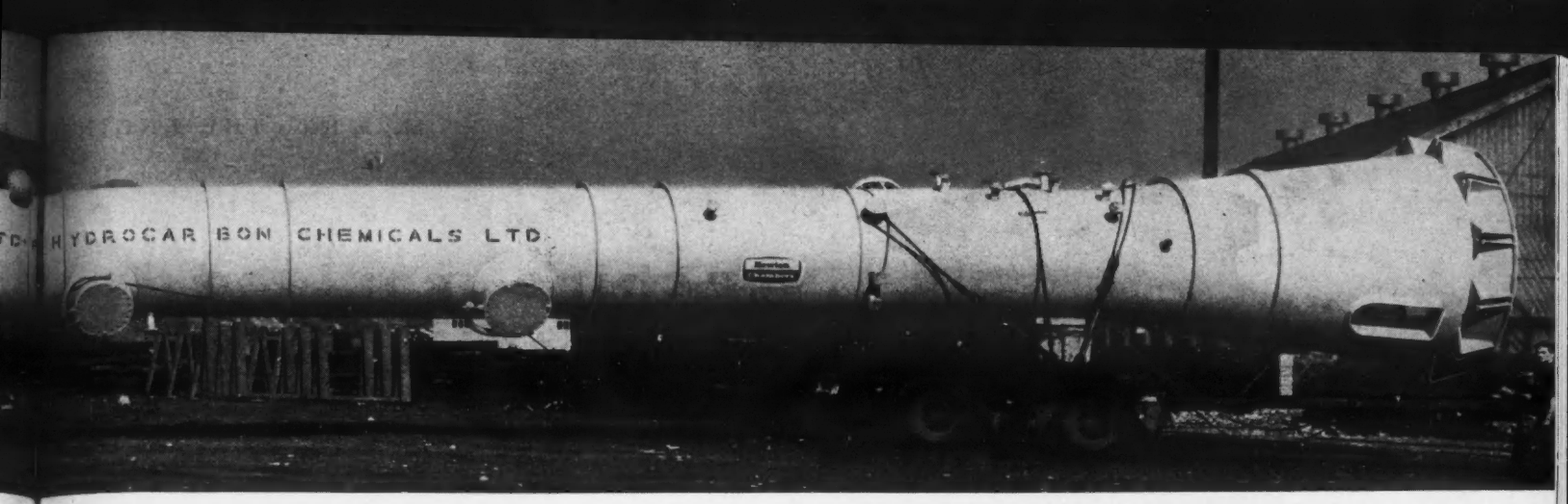


Inka air preheater





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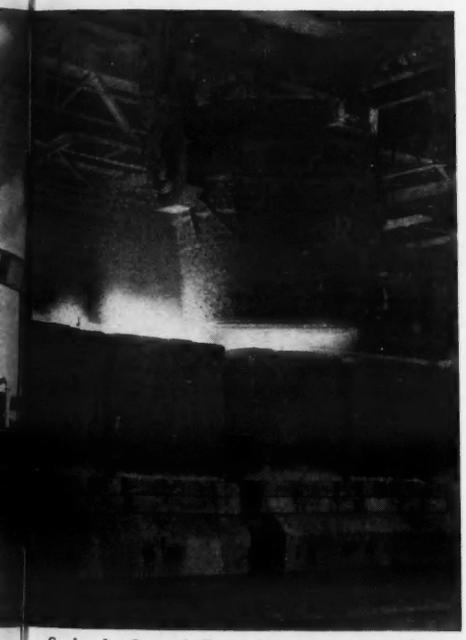

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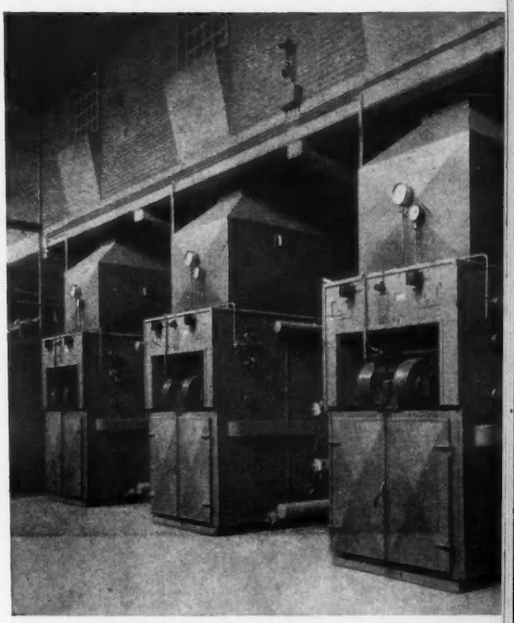
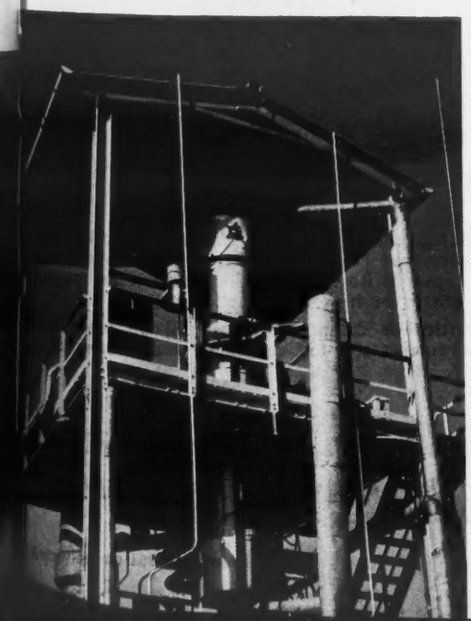
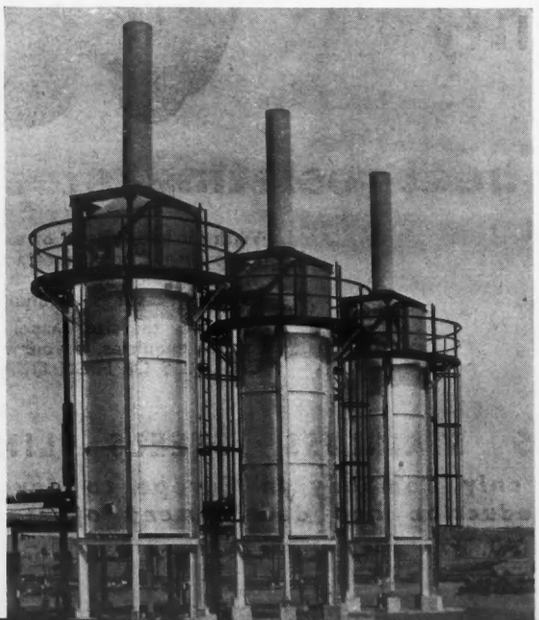


Redfyre Emma Coke Fired Boilers

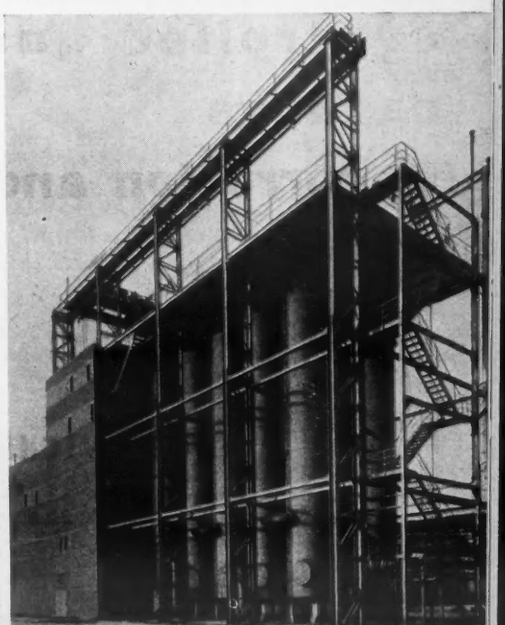
Hydro Refining Pilot Plant at Thorncliffe



Struthers Wells direct-fired heaters



High pressure gas purification plant to Bischoff designs



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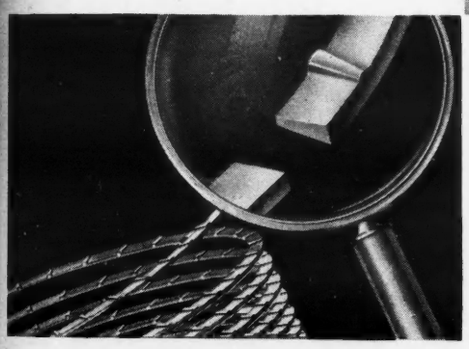

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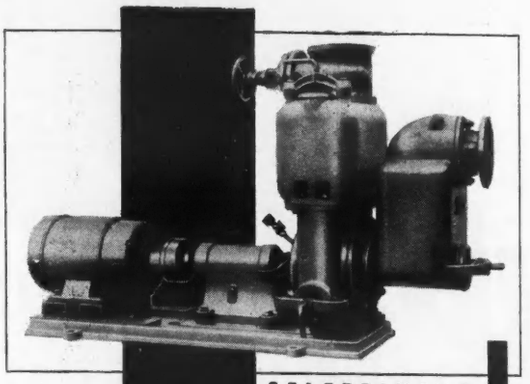

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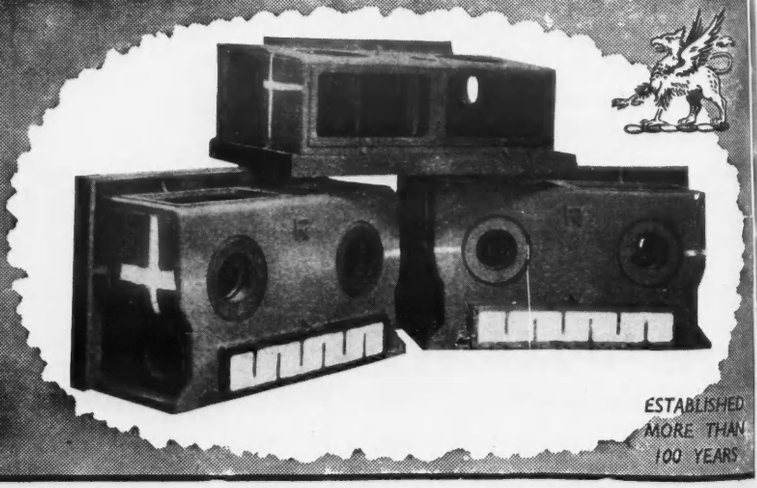

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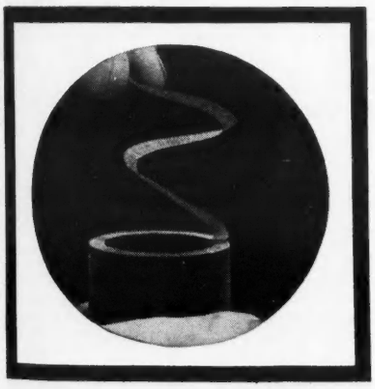

Tecalemit Ribbon Filter Elements

Simple construction—Low cost—High flow rate—Easy to clean

The elements are formed of resin impregnated cellulose ribbon, wound helically and electrically fused into an open-ended cylinder. Innumerable microscopic orifices between the ribbons allow a very high flow rate, while retaining impurities on the outside or inside surfaces, according to direction of flow.

The standard range of diameters (in any length) covers most applications, and no other filtration material can so readily be adapted to individual requirements for filters, strainers, breathers or separators. Never before has such fine filtration been possible at such low cost and with such flexibility in use.

Tecalemit Ribbon Elements filter to maximum purity

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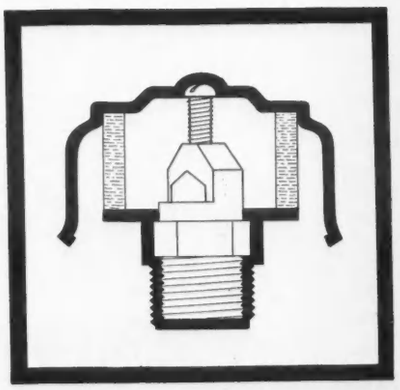
Tecalemit Breathers act as ventilators to provide a free flow of clean air to hydraulic fluid, fuel and oil reservoirs. They give positive protection from airborne contamination to tanks, pumps, valves, cylinder and other engine components. Of the standard types, two are breathers with screwed bodies, and the third is a combined clip-on assembly of breather and filter cap. All are fitted with Tecalemit Ribbon Filter Elements.

Tecalemit Breathers provide pure air cheaply and efficiently



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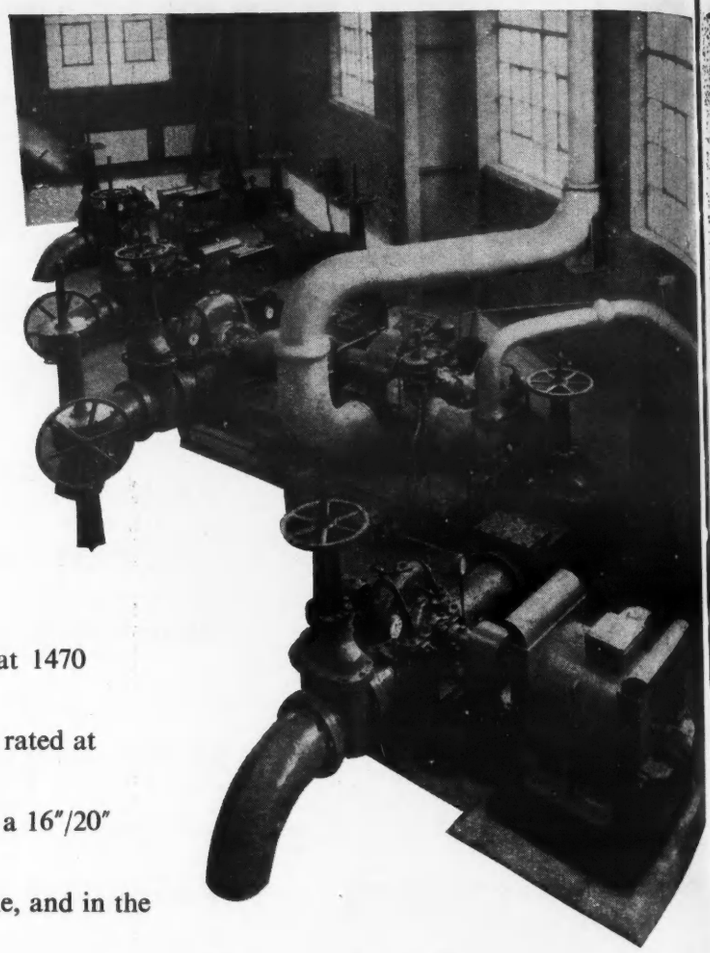

Mather & Platt pumps and motors on furnace cooling duty in the pump house of a large steel works. In the foreground is a 12″/15″ Medivane delivering 4500 g.p.m. against a 140ft. head and driven at 1470 r.p.m. by a drip-proof squirrel-cage motor rated at 260 b.h.p., 2750 volts ; next to this is a 16″/20″ Medivane driven by a steam turbine, and in the background are two 17″/20″ Lonovanes driven by drip-proof squirrel-cage induction motors.

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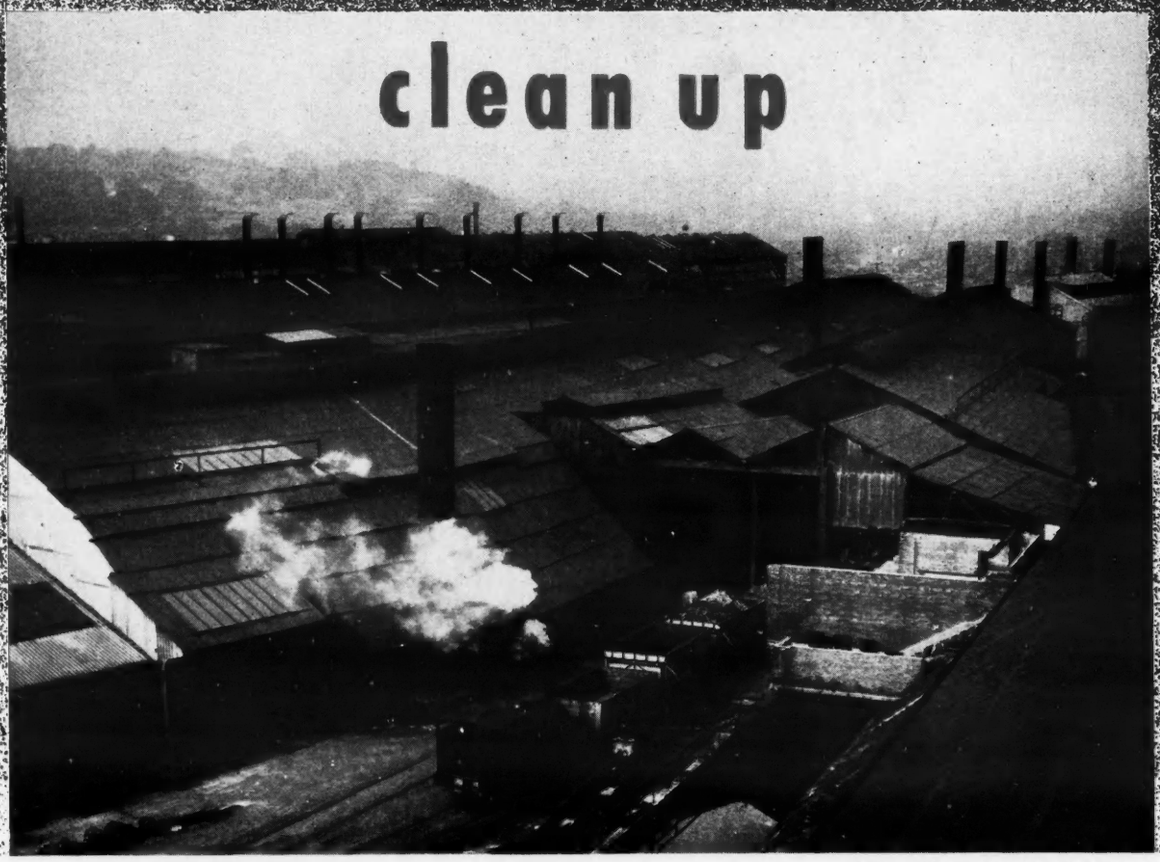

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THE CONTROL PANEL shown on the opposite page will do an important job at the Carrington Works of the Shell Chemical Company Limited: it will control the fully automatic PERMUTIT plant producing nearly a million gallons daily of very pure water for boiler feed. This plant is typical of many recently designed and manufactured by Permutit for new industrial projects.

In every manufacturing process, water is an essential basic material. Steel, oil, chemicals, textiles: all rely on large quantities of water that must be purified to exacting standards. For some purposes, clean and sparkling filtered water meets the need, and for others, scale-forming salts must be eliminated. More critical applications call for water completely free from all dissolved solids: water of this high purity is produced cheaply in any quantity by Permutit plant.

In Electronics, very pure water is essential in many production processes—particularly in the manufacture of cathode ray tubes, and in the preparation of germanium wafers for transistors. This water is produced by Permutit "Deminrolit" plant—it is so pure that care must be taken to avoid its contamination by atmospheric impurities.

In Aviation, the galleys on Comets are equipped with Permutit drinking water filters, and Permutit De-Salting Kits are provided in emergency survival dinghies. On the Boeing 707, hundreds of gallons of pure water—by Permutit—are injected into the turbo-jets to give increased thrust for take-off.

In Ford's new Paint, Trim and Assembly Works, body shells are repeatedly rinsed with water during the stages of spraying and rubbing down. To ensure perfect finish, very pure water is needed: a Permutit plant supplies treated make-up, and also purifies dirty water for re-use.

In Britain's Nuclear and Fossil Fuel Stations, the make-up for the boilers is treated by Permutit "Deminrolit" plant that provides water free from silica and dissolved solids, with an electrical conductivity of less than 0.5 micromhos per cm^3.

You use water in your industry, but is its quality good enough for today's needs or tomorrow's planning? Bad water can ruin expensive plant and make process costs uneconomic: good water by Permutit saves money and often opens the way to better manufacturing methods.

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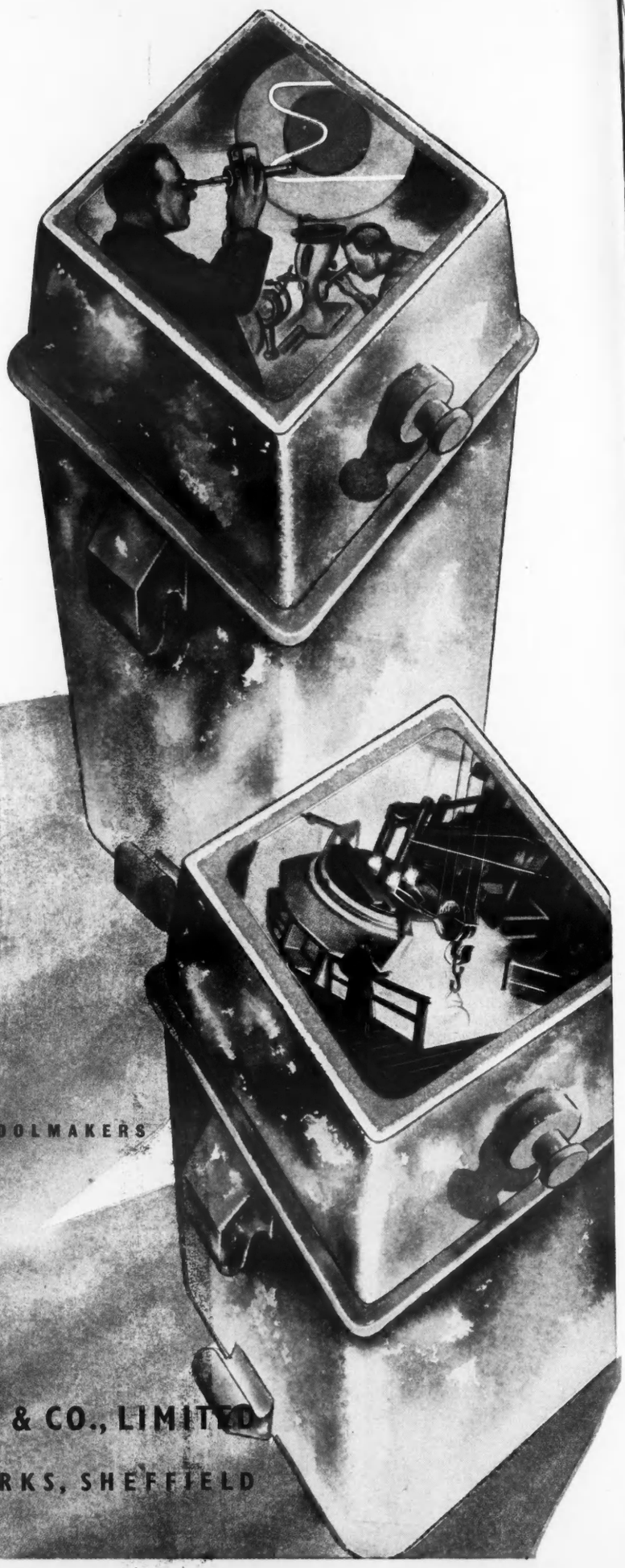

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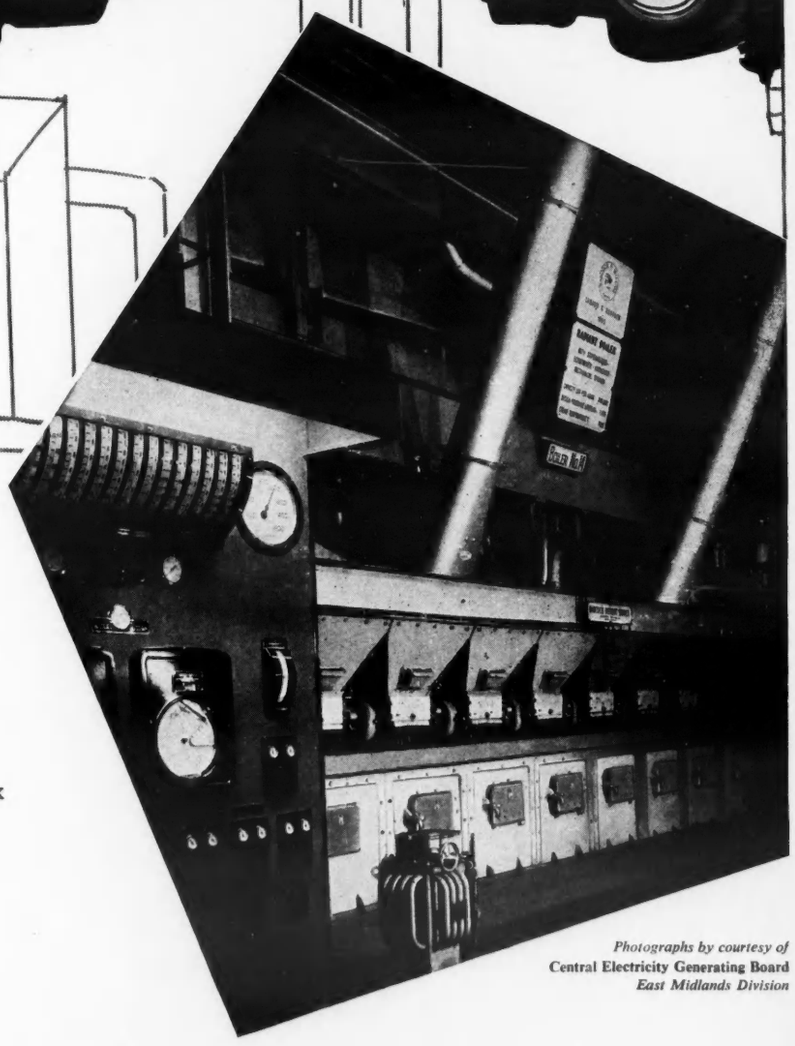

Well known in the Automotive and Railway Industries, Hardy Spicer are now supplying propeller shafts and universal joints in increasing quantities for other engineering applications. Typical of these are the universal joints incorporated in the drive shafts used on the Babcock & Wilcox Feeder Stokers at Staythorpe Power Station—Newark, Notts. Hardy Spicer's wide experience ensures the highest standards of design and performance. Please write for further details and illustrated leaflets.

Photographs by courtesy of
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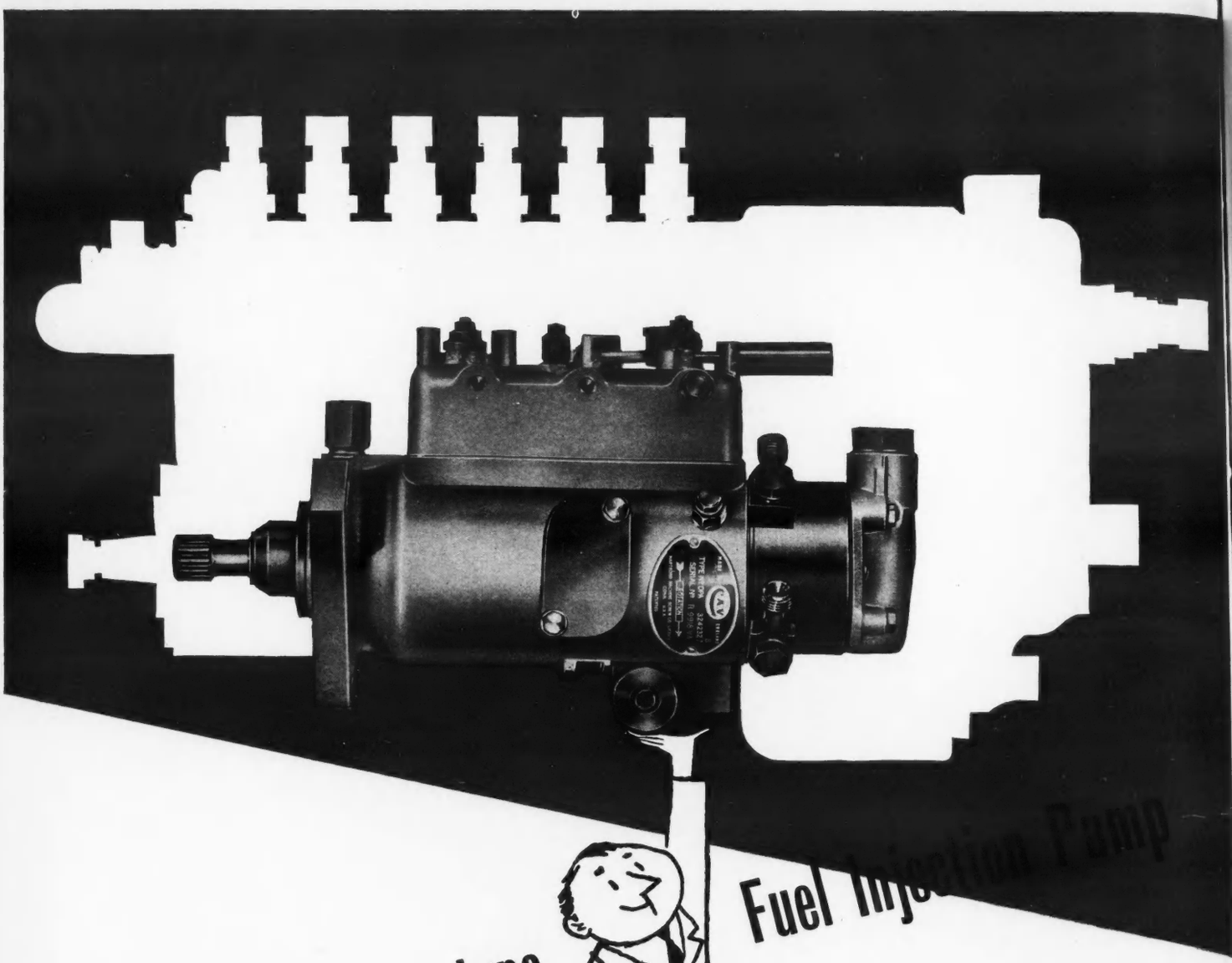

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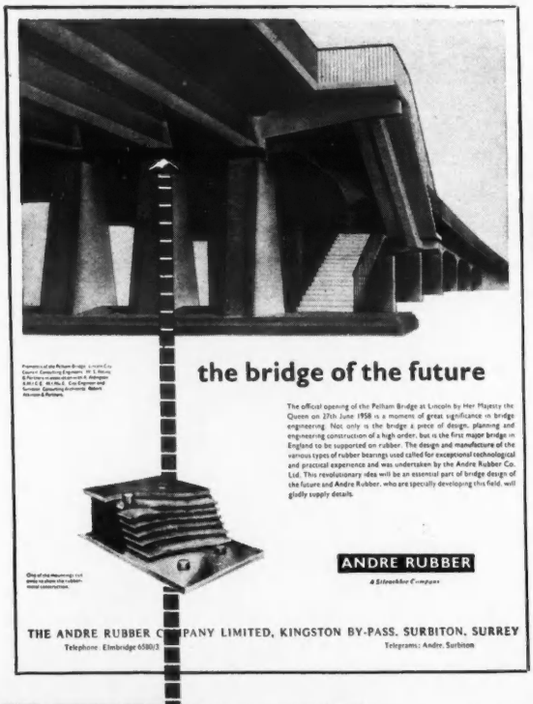
the bridge of the future
The official opening of the Pelham Bridge at Lincoln by Her Majesty the Queen on 27th June 1958 is a moment of great significance in bridge engineering. Not only is the bridge a piece of design, planning and engineering construction of a high order, but is the first major bridge in England to be supported on rubber. The design and manufacture of the various types of rubber bearings used called for exceptional technological and practical experience and was undertaken by the Andre Rubber Co. Ltd. This revolutionary idea will be an essential part of bridge design of the future and Andre Rubber, who are specially developing this field, will gladly supply details.
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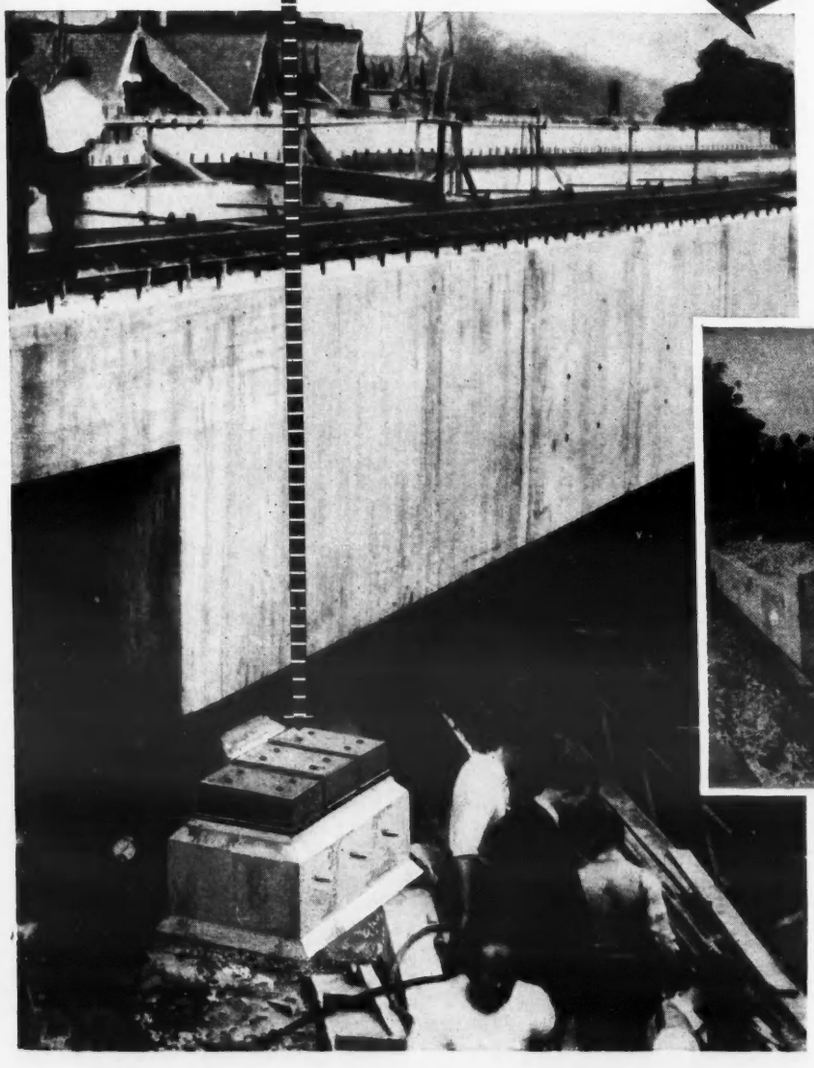
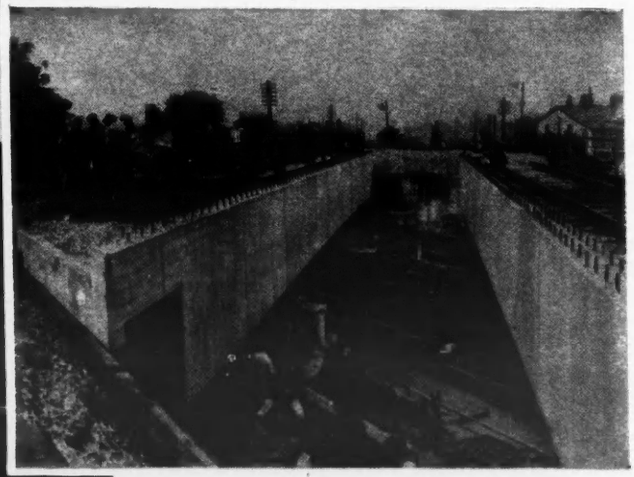
Photograph by courtesy of British Railways





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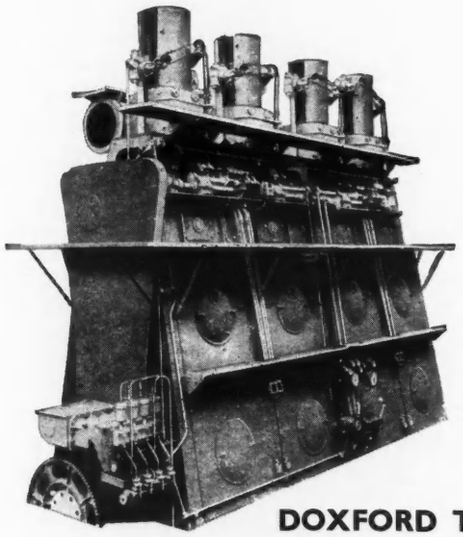

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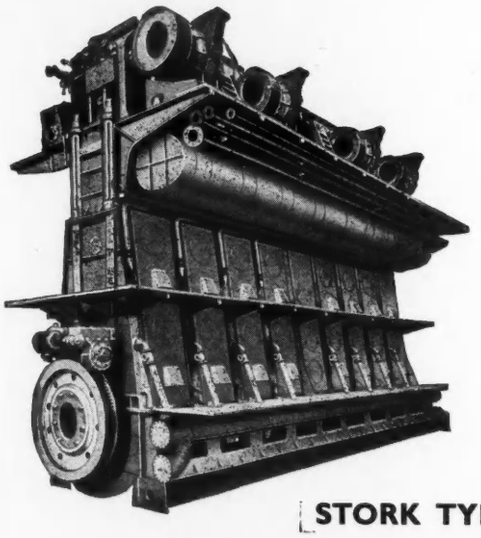

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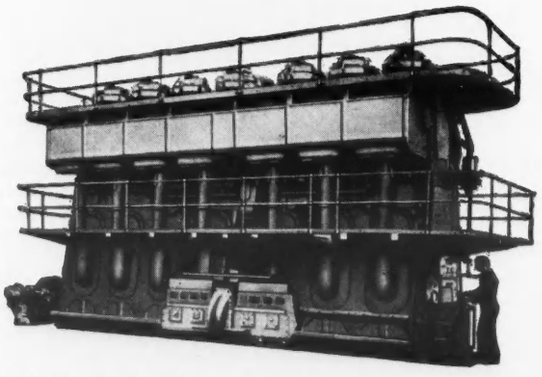

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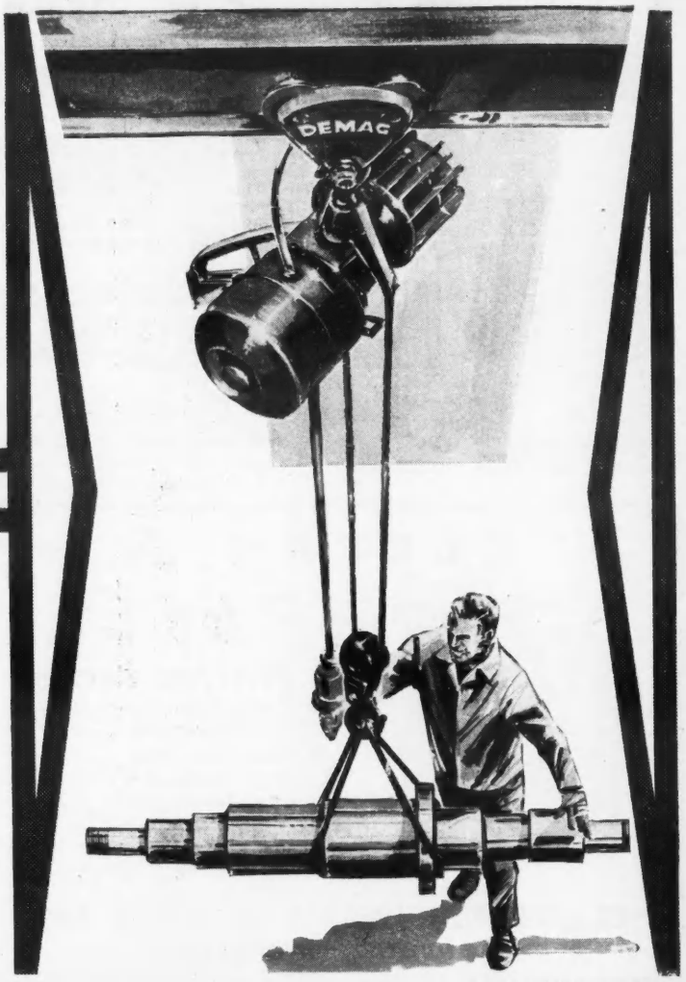

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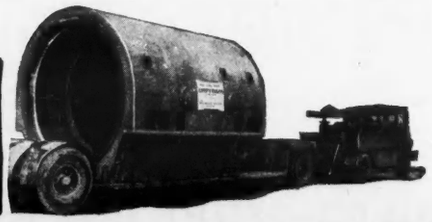
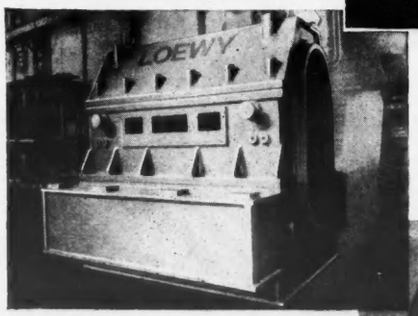
Heavy Welded Fabrications





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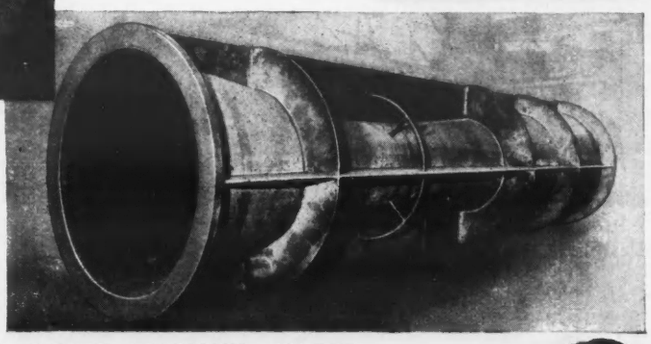

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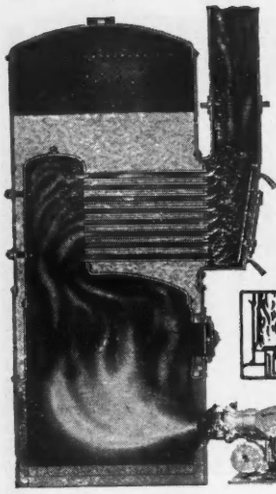

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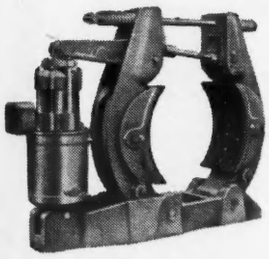

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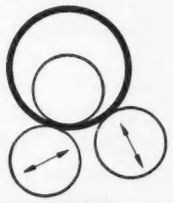
BRONX

PLATE BENDING ROLLS

Illustrated is a Bronx 8′ × ¾″ capacity machine, installed at Messrs. Carrier Engineering Co.



Bronx Plate Bending Rolls reduce costs on batch and mass production work as well as on accurate "one off" cylinder jobs.

Every machine is supplied with a capacity chart giving widths, thicknesses and diameter capacities. This information is essential to your Estimating Dept., as well as the operator on the machine.

There is a wide range of massively built Bronx Plate Bending Rolls to give consistent accuracy with thinnest to thickest steel plates up to 40 ft. in width, and standard machines cope perfectly with conical work.

There are also Bronx Press Brakes, Tube Straightening Machines, Bar Reeling Machines, Roller Levellers, etc. Write for Catalogues.

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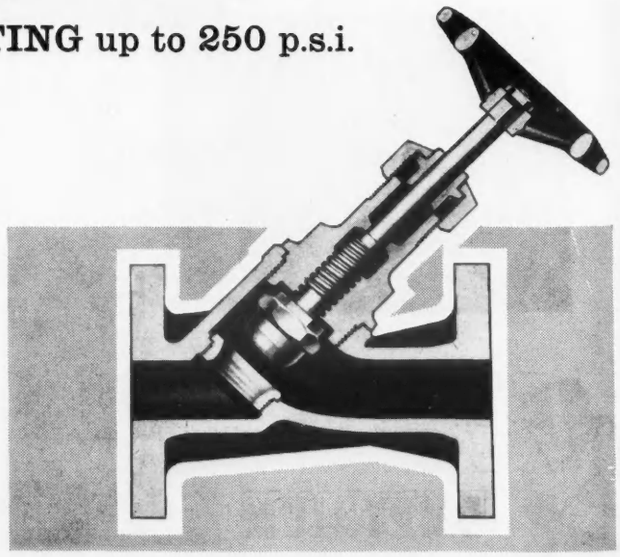
7. New Design Handwheel for comfortable and effective operation.
8. Available with Double Regulating Device for proportionate control of flow at all settings.
9. **Fig 1200 also suitable as a general purpose steam stop valve.**

There are 3 models of this valve in sizes from ½ in. to 2 in.
1. Fig 1200 GM 'Y' Type Stop Valve. 2. Fig 1200R GM 'Y' Type Regulating Valve. 3. Fig 1200 DR GM 'Y' Type Double Regulating Valve.

Please write for the brochure in which they are described and illustrated.



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Jones cranes

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*

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WE OFFER A FIRST PRIZE OF 250 GUINEAS for the best black and white PHOTOGRAPH of a JONES MOBILE CRANE operating anywhere in the world.

There will be a **Second Prize of 100 guineas,** a **Third Prize of 75 guineas,** a **Fourth Prize of 50 guineas,** and five consolation prizes of 25 guineas each.

All submissions will be eligible for the main competition, but a prize of 5 guineas will be awarded for the best photograph submitted each month between now and the end of the year.

We have many photographs of Jones Cranes, showing their industrial capabilities and versatility; what we are here seeking are pictures in which the accent is on photographic art.

Professional photographers may compete, but there must be many keen and talented amateurs in industry for whom a Jones Crane would provide an interesting subject for photography.

Entries will be judged by a panel of professional and skilled amateur photographers whose decision will be final.

Prints should be on glossy paper and of whole plate size ($8\frac{1}{2}'' \times 6\frac{1}{2}''$). Any number of prints may be submitted. On the back of each must be the competitor's name, address, business appointment (if any), date, place at which the crane was photographed and (if possible) the name of its owner and its driver.

It is a condition of the Competition that we have the right to reproduce and exhibit any submitted prints either before or after final judging takes place.

The closing date is December 31st, 1960. Entries should be addressed to The Manager, Group Publicity Department (P.C.4). The George Cohen 600 Group Ltd., Wood Lane, London, W.12. Envelopes should be marked "Jones Crane Photographic Competition" in the top left-hand corner. The result will be announced in this and other journals during April, 1961.

Jones cranes

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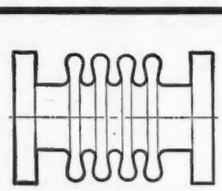
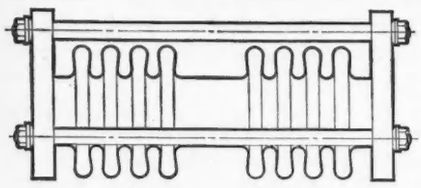
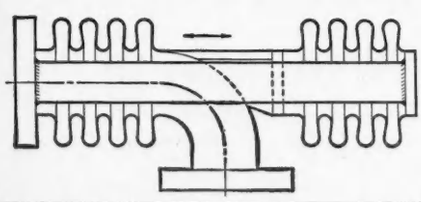
GENFLEXIBILITY



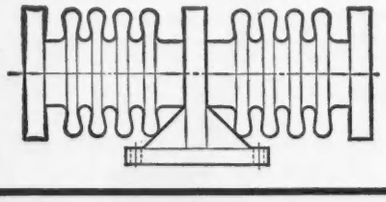
Genflex Single Expansion Joint for axial movement — the simplest form of bellows.



Genflex Tied Universal Expansion Joint — to absorb lateral deflection with no pressure loading on pipework.



Genflex Pressure Balanced Expansion Joint — designed to allow for axial movement and lateral deflection while absorbing the end thrust.



Genflex Double Expansion Joint — contains two bellows joined by a common connector to which an anchor base is attached.

The illustrations above show just a few of the many types of Genflex expansion joints produced to accommodate various pipe movements.

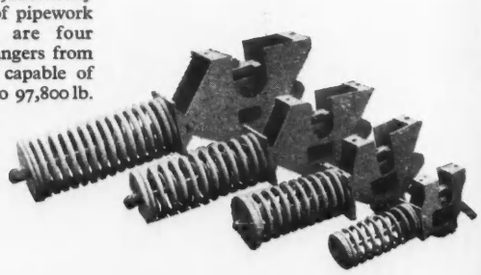
with the new GENFLEX EXPANSION JOINTS

Genflex bellows expansion joints are the easiest and most economical method of absorbing thermal expansion and contraction in pipework systems. Made by Vokes Genspring Limited, the largest manufacturer of compensated pipe hangers in Europe, they combine the advantages of absorbing vibration and movement in all planes with extreme simplicity of installation and elimination of maintenance. Standard Genflex expansion joints are formed from stainless steel sheet with a longitudinal butt weld and are available in sizes from 3″ bore to 120″ bore. Great care is taken during the manufacture of the joints and special test equipment installed in the Vokes Genspring test bay ensures rigid adherence to manufacturing tolerances and standards. On completion the units are subjected to stringent pressure and pulse cycling tests to determine fatigue limits.

Genflex expansion joints can also be used in shaft seals and packless glands, expansion pockets, packless valves and mechanisms, flexible joints and in many other applications. Joints can be designed and manufactured for special requirements to larger diameters than 120″ bore and in a wide variety of metals and alloys. A staff of specialist Vokes Genspring engineers is always available to help with the correct siting of bellows, anchors, pipe guides, etc., and to enable the best possible arrangement of pipework to be adopted. **Please write for the Genflex catalogue.**

GENSPRING PLUS GENFLEX
the perfect combination for controlling movement and stresses in pipelines.

Vokes Genspring suspension equipment can now be used in conjunction with Genflex expansion joints to give a unique, absolutely reliable, and versatile system of pipework control. Illustrated (right) are four Genspring constant support hangers from the new 'M' range which is capable of supporting loads from 315 lb. to 97,800 lb. Please write for further details.



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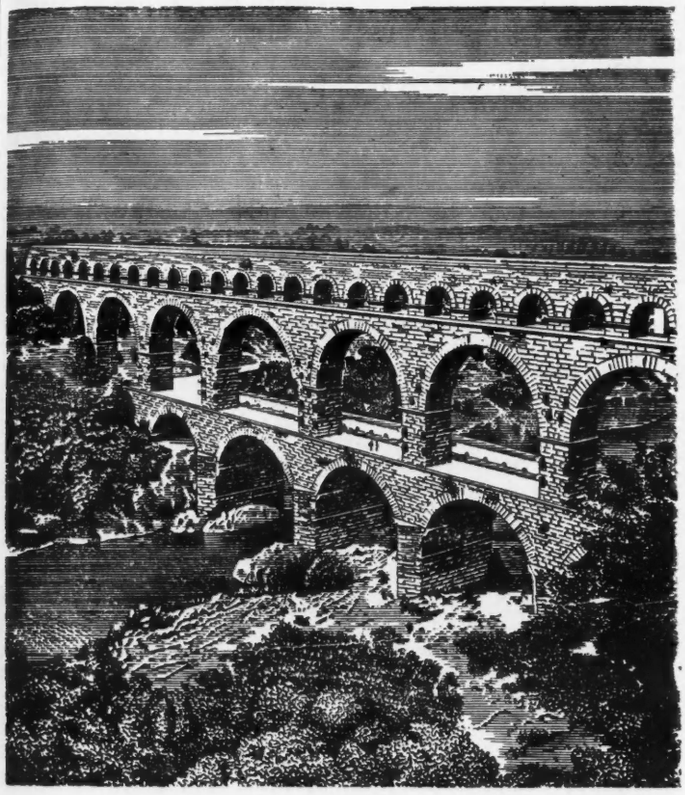

Wonders of the World

BUILT at Nimes, France, in 19 B.C., this Roman bridge was originally part of an aqueduct constructed to carry water from Uzès to Nimes. It is one of the noblest memorials of Roman architecture and an interesting feature is that the masonry is dry-jointed. Along the topmost tier runs the channel by which water was conveyed, the cement lining being of lime and terra-cotta. The structure is nearly 900 feet long and reaches a height of 160 feet. The lower arches each have a span of over 60 feet and now carry a modern road.

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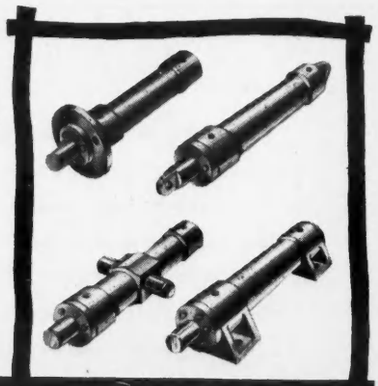

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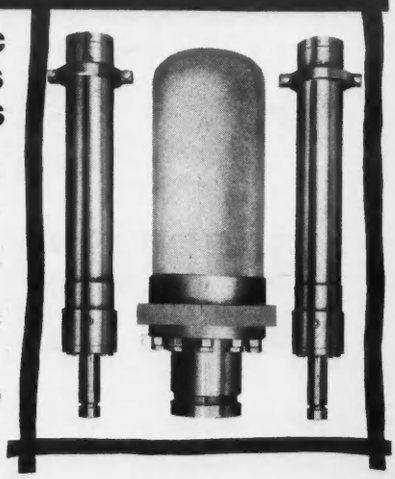

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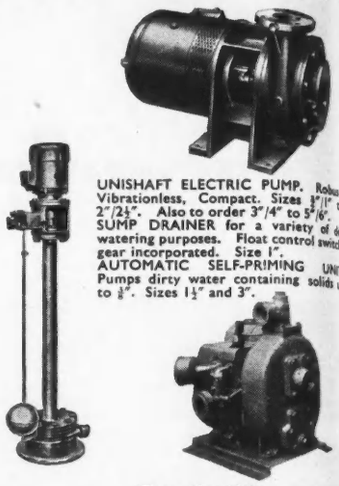

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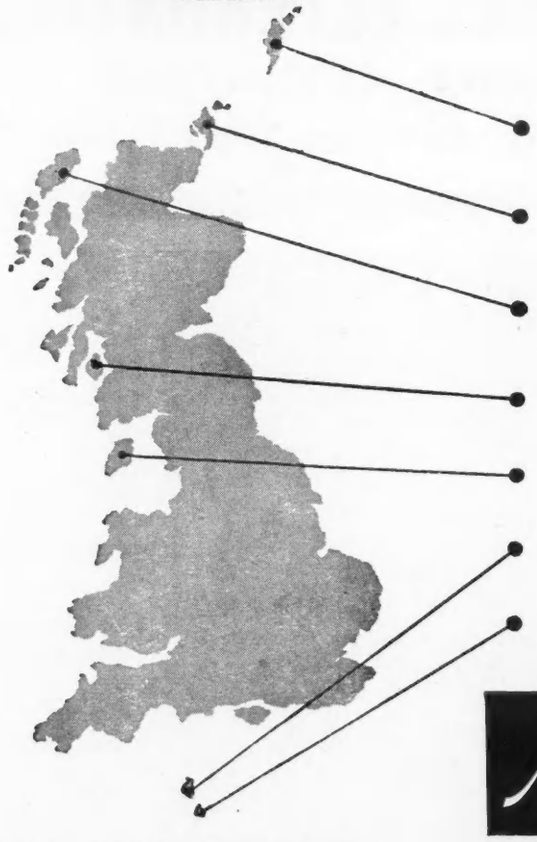

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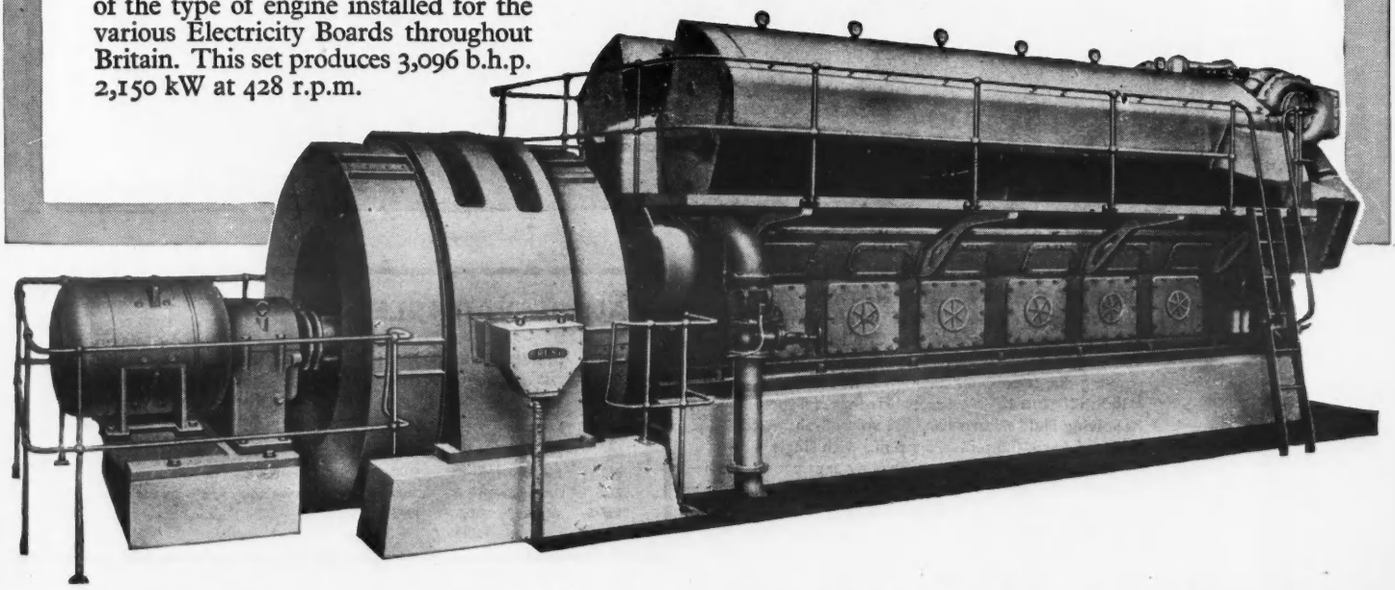

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ALSO AVAILABLE:—

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K.V.A.	Make	R.P.M.
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312	Petter/Brush	500
250	Petter/Brush	600
187·5	Waukesha/G.E.	1000
162·5	Crossley/L.D.C.	500
125	Blackstone/C. Park.	500
62·6	National/Brush	1000
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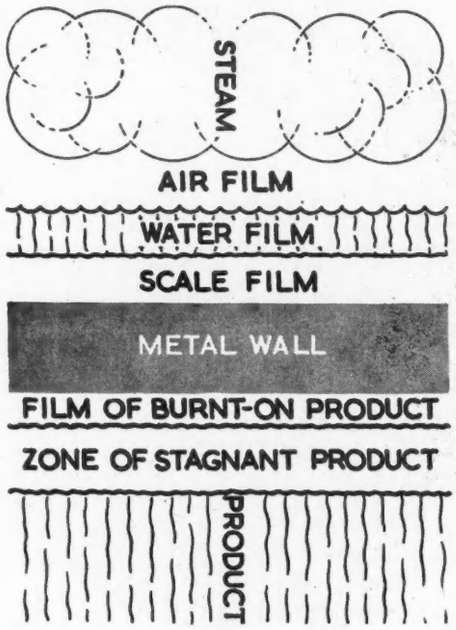

OUR sketch shows process steam users their particular layers of trouble. It is the most important diagram in our Bulletin " Steam for Process ", for it shows why the whole idea of boiler, transmission and process plant can fall sadly short of full processing realisation.

Can fall? *Will* fall, unless those barrier films are minimised. Unless efficient water and air removal from all the steam plant is practised with as much zeal as engineers devote to descaling their boiler heating surfaces. Higher and better production can be got from the same input if these barrier films are reduced. Reducing them is a matter of sound steam trapping and air venting, subjects on which " Steam for Process " is a mine of help.

Why not glance through your " Steam for Process " again to check whether you're missing anything? And please give a thought for any colleague who hasn't his own copy. It couldn't be simpler for him to get one.

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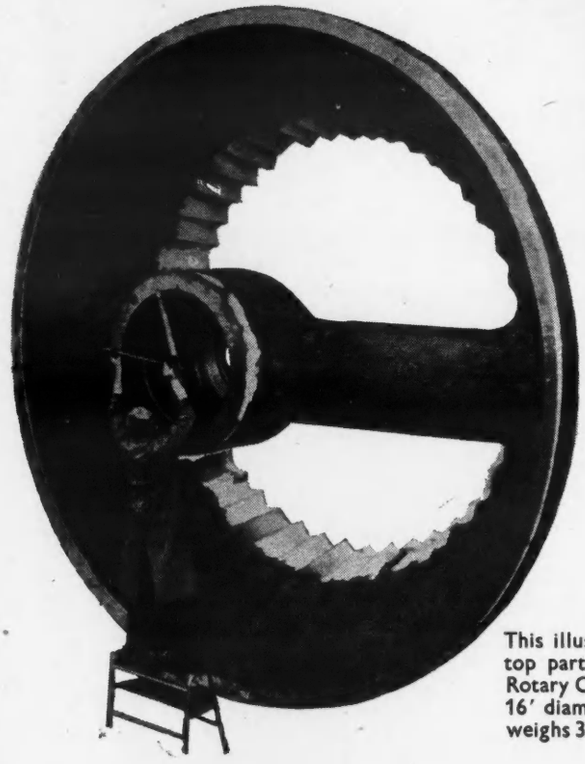
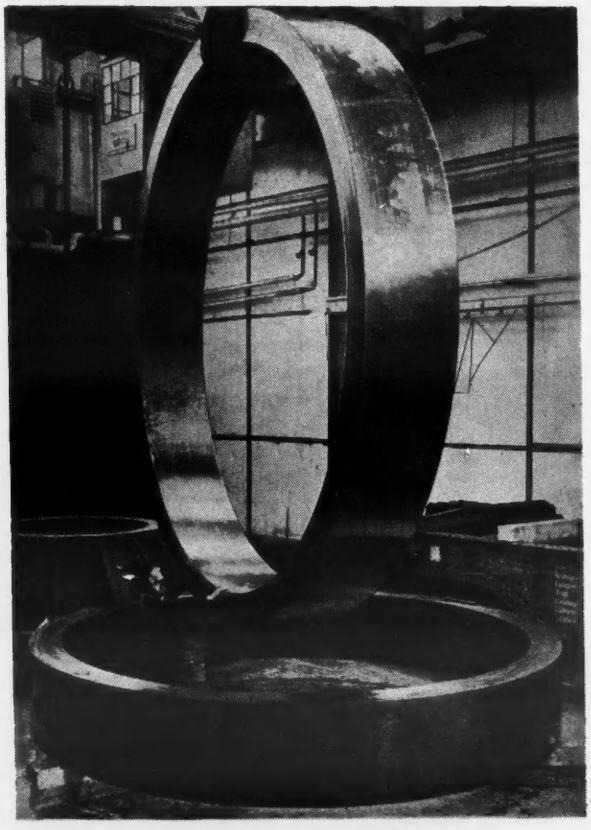
P

RUHRSTAHL FORGINGS AND STEEL CASTINGS

Shown above is a Forged Turbine Shaft of Nickel Chrome Molybdenum special steel rough turned and trepanned. This shaft for a Steam Turbine is 17′ long, the largest diameter 58″ and the smallest 14″, weight 19 tons.

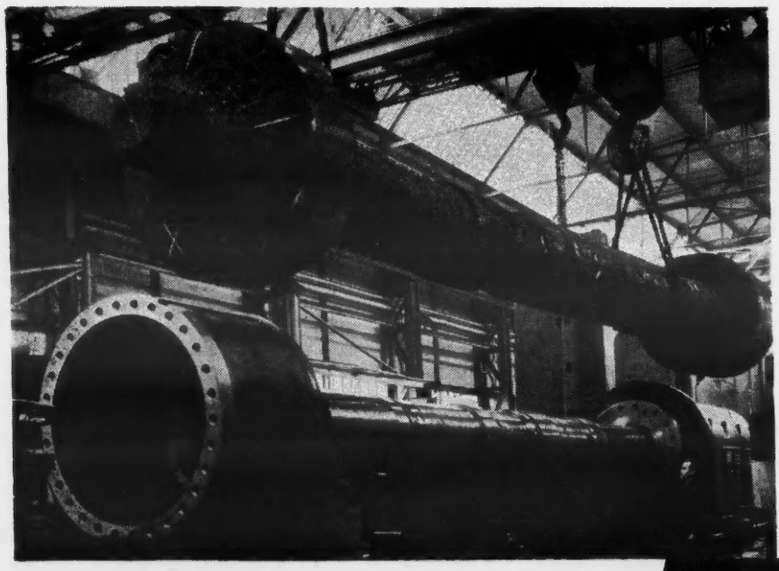


This illustration shows the top part of the Shell for a Rotary Crusher in cast steel 16′ diameter and 7′ high it weighs 36 tons 3 cwt.



The illustration above shows a Cast Steel Tyre 17′ 4″ dia. × 29½″ deep, weight 25 tons. Ruhrstahl also specialise in Rolling Mill Sections for flat rings, angle rings, etc., in a wide range of standard sizes and shapes, full details available on request.

The forged Turbine Shaft shown below in the process of manufacture is made of open hearth steel. The largest diameter is 78″, diameter of flange 68½″ and diameter of shaft 41″. The total length is 41′. Weight finish machined is 47 tons 4 cwt.



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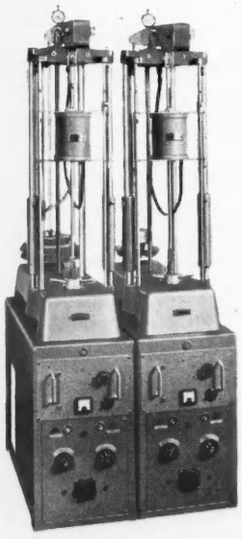

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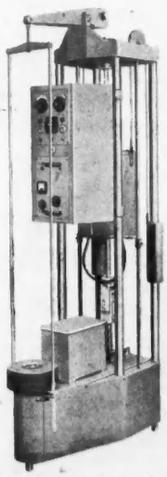
MODEL T.48
Capacity 3 tons



MODEL T.47E
Capacity 1 ton
MODEL T.45A Capacities 5 tons and 15 tons

Please let us have full details of your requirements, stating specimen dimensions, temperature range, anticipated elongation and loads to be applied.

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Tel: Leeds 7-5488 Grams: 'Weigh Leeds 10'
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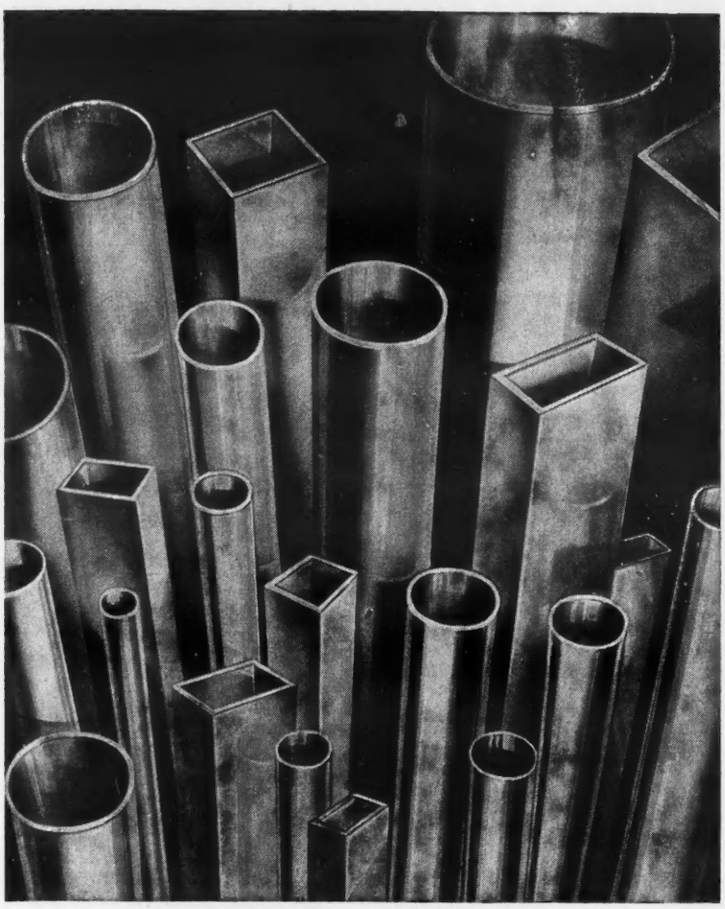

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ARNOTT YOUNG
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W. H. ARNOTT YOUNG & CO. LTD.
Brookside Tube Works, Middleton St. George
Darlington. Telephone: Dinsdale 42

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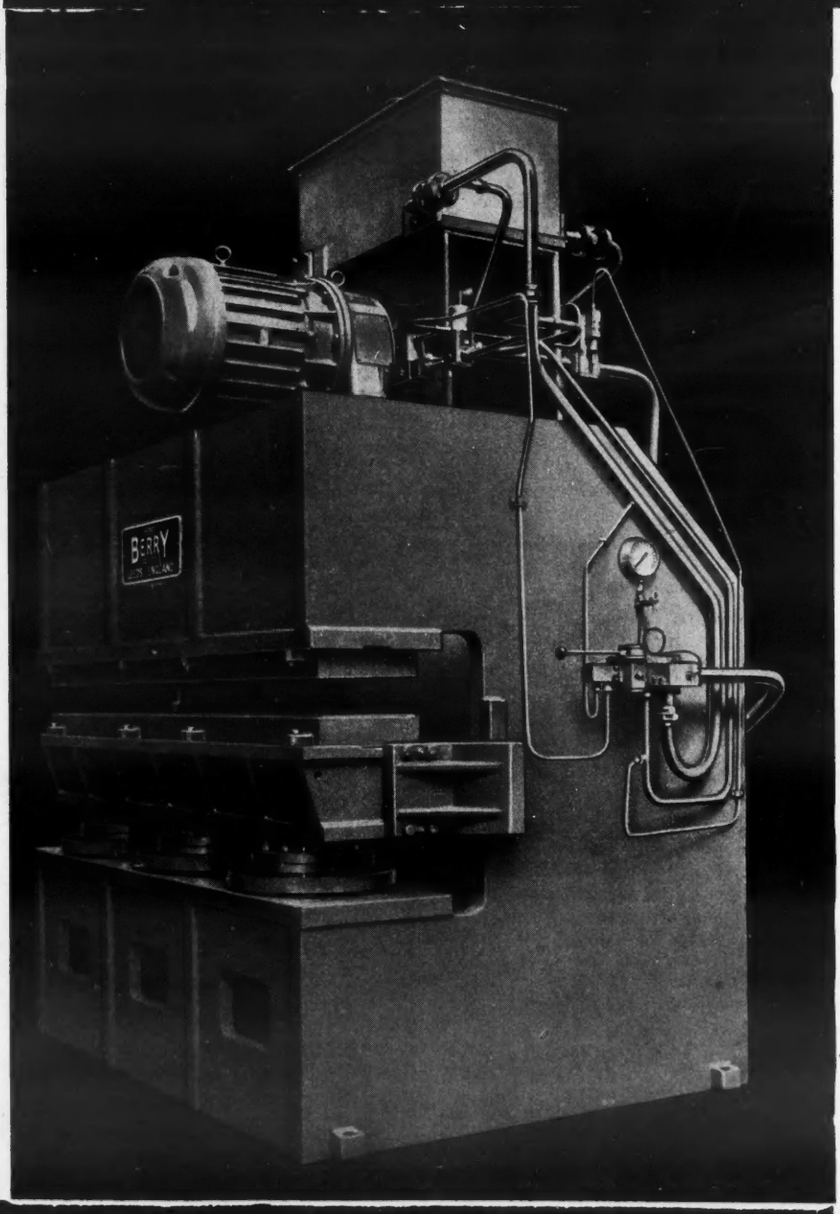
Experienced in HYDRAULICS

FOR ALMOST A CENTURY

HYDRAULIC PLATE CURVING PRESS

The press is made with dies varying from 3′ to 8′ long, but it will progressively curve plate edges of any length prior to rolling. The frame is of all welded steel construction and has two or more upstroking rams and cylinders. These presses can be made to work from an existing hydraulic supply or supplied with electrically driven self-contained pumps.



We also manufacture

High Pressure Hydraulic Plant for Shipyards and Railway Workshops, Plate Bending Rolls, Punching and Shearing Machines, Continuous Finishing Presses for Silks and Rayons, Veneer and Plywood Presses, Cotton Baling Presses, Die Spotting Presses, Pumps, Accumulators, Valves and Intensifiers.

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Telegrams : "RIVETTER LEEDS 10"
Telephone : LEEDS 75481/2

HB

Enter No. 1401 on reply card

CLASSIFIED ADVERTISEMENTS

PUBLIC APPOINTMENTS · SITUATIONS VACANT · TENDERS · EDUCATIONAL · BUSINESSES and PREMISES · BUSINESS OPPORTUNITIES PATENTS · MISCELLANEOUS · AGENCIES · DIRECTORS · PARTNERSHIPS

Lineage Rate. 4/6 per line of approximately 6 words. Minimum 18/–. **Inch Rate.** 54/– per single column inch and pro rata. 12 lines to 1 inch.

There are reduced rates (i.e., not on a pro rata basis) for advertisements of ¼-page (12 column inches) and upwards, e.g., ¼-page £29 10s. ½-page £54. Full page £100.

FOR SALE · MACHINERY, etc., WANTED · AUCTION SALES · SITUATIONS WANTED · SUB-CONTRACTING · DESIGN SERVICES · FOR HIRE

Lineage Rate. 4/– per line of approximately 6 words.. Minimum 16/–. **Inch Rate.** 48/– per single column inch and pro rata. 12 lines to 1 inch.

There are reduced rates (i.e., not on a pro rata basis) for advertisements of ¼-page (12 column inches) and upwards, e.g., ¼-page £25 10s. ½-page £48. Full page £90.

Run-On and Semi-Displayed Styles. Both these styles are available for single column width advertisements of any depth up to 12 inches.

Displayed and Illustrated Styles. The minimum size for a Displayed advertisement is 3 inches single column, for an illustrated advertisement it is a ¼-page (12 column inches). Thereafter the sizes for both progress in steps 3 inches deep across 1, 2, 3 or 4 columns.

Use of Box Number. 2/– which includes forwarding of replies.

Copy Dates. Tuesday for publication on Friday same week. If proofs are wanted, copy is required on Thursday for publication on Friday of the following week.

Advertisements for publication should be addressed to :—**Classified Advertisement Dept., "THE ENGINEER," 28 Essex Street, Strand, London, W.C.2**

Urgent advertisements may be telephoned to CENtral 6565.

PUBLIC APPOINTMENTS

DERBY AND DISTRICT COLLEGE OF TECHNOLOGY

Principal : T. HEAP, Ph.D., M.Sc., F.R.I.C., A.M.B.I.M.

MECHANICAL ENGINEERING DEPARTMENT

APPOINTMENTS

Applications are invited for the following posts in the Mechanical Engineering Department, duties to commence 1st September, 1960.

1. SENIOR LECTURER to specialise in Strength of Materials and Modern Methods of Material Testing. Applicants should have a good Honours degree, good industrial and teaching experience.

2. LECTURER to teach Theory of Machines, Applied Mechanics, Thermodynamics or Mechanics of Fluids to H.N.C., H.N.D. and London B.Sc. Standard. Applicants should have a University degree or equivalent and good industrial and teaching experience.

3. ASSISTANT, GRADE "B" (TWO posts to teach Workshop Technology, Workshop Science and Engineering Drawing. Applicants should have a Final Certificate in Machine Shop Engineering or equivalent.

4. ASSISTANT, GRADE "A" (TWO posts) to teach Science, Drawing and Technique to students in Machine Shop Engineering, Sheet Metal Work, Steel Fabrication, Welding, Foundry and Pattern-making, or Motor Vehicle Mechanics courses. Applicants should have a City and Guilds Certificate in one of the trades subjects, and be prepared to teach general subjects in other courses.

Salary will be in accordance with the Burnham Technical Scales :

Senior Lecturer : £1550 by £50 to £1750.
Lecturer : £1370 by £35 to £1550.
Assistant, Grade "B" : £700 by £27 10s. to £1150.
Assistant, Grade "A" : £520 by £27 10s. to £1000.

Application forms and further particulars can be obtained from the Principal, Derby and District College of Technology, Kedleston Road, Derby, by whom completed applications should be received not later than two weeks after the appearance of this advertisement. E9670

BRADFORD INSTITUTE OF TECHNOLOGY

Applications are invited for the posts of :

SENIOR LECTURER IN MECHANICAL ENGINEERING
LECTURER IN MECHANICAL ENGINEERING

Candidates should be well-qualified and industrial and research experience would be a recommendation. The successful candidates will be required to teach one or more subjects to honours degree standard. They will be encouraged to undertake research and adequate facilities will be available.

Salary scales : Senior Lecturer, £1550 to £1750 per annum. Lecturer : £1370 to £1550 per annum. Previous industrial and research experience at a suitable level may be taken into account in fixing the commencing salary.

Further particulars and forms of application may be obtained from the Registrar, Bradford Institute of Technology, Bradford, 7.

H. PATTEN,
E9724 Clerk to the Governors.

UNIVERSITY OF NOTTINGHAM

RESEARCH FELLOWSHIP IN PRODUCTION ENGINEERING

Engineers, Physicists or Mathematicians interested in the study of Production Processes or the Application of Statistics to Production Problems are invited to apply for the above Fellowship. Value £750 per annum, plus membership of the Universities Superannuation Scheme. Industrial or research experience an advantage. Conditions of appointment and application form, to be returned by 31st May, from the Registrar. E9648

PUBLIC APPOINTMENTS

CARMARTHENSHIRE EDUCATION COMMITTEE

PIBWRLWYD RURAL TECHNICAL COLLEGE, CARMARTHEN

HEAD OF ENGINEERING DEPARTMENT

Applications invited for post of HEAD OF ENGINEERING DEPARTMENT at the above College. Candidates should possess a University degree in Mechanical Engineering together with qualifications in Agricultural Engineering and teaching experience. Pibwrlwyd is a semi-residential College situated within one mile of the County town of Carmarthen. Expansion plans for the College have been accepted by the Ministry of Education. The successful applicant would be responsible for developing Agricultural Engineering courses at the College possibly to Diploma level and would be expected to take an active interest in development work on the College Farm, which is being modernised.

Salary, Grade I, Head of Department, Burnham Further Education Report, 1959, i.e., £1420 to £1600.

Application forms may be obtained from the undersigned on receipt of a stamped, addressed foolscap envelope, and must be returned not later than Saturday, 21st May, 1960.

IORWERTH HOWELLS,
Director of Education.
County Education Offices,
County Hall, Carmarthen. E9704

MANCHESTER COLLEGE OF SCIENCE AND TECHNOLOGY

(FACULTY OF TECHNOLOGY IN THE UNIVERSITY OF MANCHESTER)

LECTURESHIP IN MATHEMATICS

Applications are invited for a LECTURESHIP IN MATHEMATICS in the College with corresponding title and status in the University of Manchester.

Applicants must be graduates and either mathematicians with experience of engineering or engineers with mathematical ability. The person appointed will be expected to lecture to students taking degrees in Mathematics or to students in other departments of the Faculty, and to take an active part in the research work of the department.

Salary according to experience in the range £900 by £50 to £1350 by £75 to £1650, with F.S.S.U. and children's allowances.

Further particulars and forms of application may be obtained from the Registrar, The Manchester College of Science and Technology, Manchester, 1, to whom completed forms should be returned by Saturday, 14th May, 1960. E9658

NIGERIAN COLLEGE OF ARTS, SCIENCE AND TECHNOLOGY

SENIOR TECHNOLOGIST OR A TECHNOLOGIST

Applications are invited for a SENIOR TECHNOLOGIST or a TECHNOLOGIST for the engineering laboratory and workshops for students preparing for University of London B.Sc. (Eng.) in Special Relationship.

Qualifications : Electrical—H.N.C. desirable and experience on maintenance and construction of electronic equipment and instrument maintenance.

Contract Salary Scales : Technologist, £713–£1217 per annum ; Senior Technologist, £1080–£1374 per annum, both plus inducement addition of £180–£300 per annum for overseas appointees and gratuity at £25 or £37 10s. for each completed 3 months' residential service. Entry point according to qualifications and experience. Salaries quoted include an interim addition to basic salary recently approved pending salary revision.

Partly furnished houses at one-twelfth basic salary rental. Tours 15–18 months. Children's U.K. maintenance grant up to £150 per annum, and passages assistance.

Applications (8 copies), giving age, qualifications, experience and names of 3 referees, should be sent to the Council for Overseas Colleges, 12, Lincoln's Inn Fields, London, W.C.2, by 14th May, 1960. E9689

PUBLIC APPOINTMENTS

MINISTRY OF LABOUR

U.N.E.S.C.O.

POLYTECHNIC INSTITUTE (JUNIOR COLLEGE) IN TEHERAN, PERSIA

SPECIALIST IN MATHEMATICS AND ENGINEERING DRAWING

U.N.E.S.C.O. requires a SPECIALIST IN MATHEMATICS AND ENGINEERING DRAWING for the Polytechnic Institute (Junior College) in Teheran, Persia.

Duties : Teaching and organisation of courses.

Qualifications : Engineering Degree and teaching experience in mathematics related to workshop and design problems, plus industrial experience. Working knowledge of French essential.

Duration : 1–2 years initially.

Salary : £2600, and generous allowances. All emoluments tax free.

For Job Description and application forms, write to Ministry of Labour (E.9), Almack House, 26–28, King Street, London, S.W.1. E9688

MIDDLESEX COUNTY COUNCIL EDUCATION COMMITTEE

ENFIELD TECHNICAL COLLEGE, QUEENSWAY, ENFIELD

LECTURER IN CIVIL ENGINEERING

Required from September, 1960 :

LECTURER IN CIVIL ENGINEERING to teach Civil Engineering subjects up to Diploma standard. Candidates must be University Graduates in Civil Engineering and at least Graduate Members of the Institution of Civil Engineers. They should have had industrial and/or teaching experience.

Salary within the range : £1408 to £1601 per annum.

Application forms (foolscap s.a.e.) from the Principal, to whom completed forms should be returned within 14 days of the appearance of this advertisement.

C. E. GURR, M.Sc., Ph.D.,
E9710 Secretary to the Education Committee.

UNIVERSITY OF CAMBRIDGE

DEPARTMENT OF CHEMICAL ENGINEERING

There is a vacancy for a

UNIVERSITY LECTURER OR DEMONSTRATOR

with qualifications in chemical or mechanical engineering, physical chemisty or physics.

Application forms and further information from the Secretary of the Appointments Committee, Department of Chemical Engineering, Pembroke Street, Cambridge. Closing date, 1 June, 1960.

E9690

UNIVERSITY OF CANTERBURY

CHRISTCHURCH, NEW ZEALAND

LECTURERS IN CIVIL ENGINEERING

Applications are invited for positions of LECTURER in the Department of Civil Engineering. Applicants should have a degree in Civil Engineering of a recognised University, teaching experience at a University, or have held a responsible position in a branch of Civil Engineering.

The salary attached to the positions will be at the rate of £1250 per annum, rising by annual increments of £75 to £1700 per annum. Commencing salary will be in accordance with qualifications and experience.

Approved fares to Christchurch will be allowed for the appointee, his wife and children, together with actual removal expenses within certain limits.

Further particulars and information as to the method of application may be obtained from the Secretary, Association of Universities of the British Commonwealth, 36, Gordon Square, London, W.C.1.

Applications close, in New Zealand and London, on 30th June, 1960. E9708

PUBLIC APPOINTMENTS

BOROUGH POLYTECHNIC, BOROUGH ROAD, LONDON, S.E.1

Principal : JAMES E. GARSIDE, M.Sc.Tech., Ph.D., F.R.I.C., F.I.M., F.Inst.F.

RESEARCH ASSISTANTS

Applications are invited from graduates or those about to graduate for RESEARCH ASSISTANTSHIPS in connection with the following investigations :

The Mechanical Properties of Plastics.
Mechanical Seals in Rotating Shafts.

The research projects envisaged are appropriate for submission (by a suitably qualified person) for a higher degree of the University of London.

Research Assistants are expected to undertake, as part of their duties, a limited amount of teaching for which payment is made.

Total remuneration approximately £450 to £500 p.a.

Further particulars and Application Form, which should be returned as soon as possible, obtainable from the undersigned.

FREDK. J. PACKER,
E9666 Clerk to the Governing Body.

UNIVERSITY COLLEGE OF GHANA

SENIOR RESEARCH FELLOWSHIP AND RESEARCH FELLOWSHIP IN THE POST-GRADUATE ENGINEERING RESEARCH UNIT

Applications are invited for : (A) SENIOR RESEARCH FELLOWSHIP, and (B) RESEARCH FELLOWSHIP in the Post-Graduate Engineering Research Unit. Prime duties will be to conduct research in soil mechanics.

Salary scales (under review) : (A) £G1700 by £G75 to £G2150 per annum ; (B) £G1000 by £G50 to £G1350 by £G75 to £G1800 ; £G1850 per annum. Entry point according to qualification and experience. F.S.S.U. Outfit and family allowances. Passages for appointee and family on appointment, leave and normal termination. Part-furnished accommodation at a charge not exceeding 7·5 per cent. of salary.

Detailed applications (6 copies), naming three referees, by 10th June, 1960, to Secretary, Inter-University Council for Higher Education Overseas, 29, Woburn Square, London, W.C.1, from whom further particulars may be obtained. E9684

WARRINGTON TECHNICAL COLLEGE

ASSISTANTS

Applications are invited for the following posts, which are created by expansion of the work of the college for September, 1960 :

ASSISTANT, GRADE "A" or "B" in MECHANICAL ENGINEERING to teach mainly in the National Certificate courses. The grading of the post will depend on qualifications and experience.

ASSISTANT, GRADE "A" or "B" in MACHINE SHOP ENGINEERING to teach mainly in the C.G.L.I. courses in Machine Shop Engineering. The grading of the post will depend on qualifications and experience.

Salary : Grade "B"—£700 by £27 10s. to £1150. Grade "A"—£520 by £27 10s. to £1000 with additions for qualifications and training and increments for industrial experience.

Application forms and further particulars may be obtained from the Chief Education Officer, Education Offices, Sankey Street, Warrington. E9700

UNIVERSITY OF AUCKLAND

NEW ZEALAND

LECTURESHIP IN CIVIL ENGINEERING

Applications are invited for the above-mentioned appointment.

The salary scale is £1250–£1700 per annum and an allowance is made towards travelling and removal expenses.

Further particulars and information as to the method of application must be obtained from the Secretary, Association of Universities of the British Commonwealth, 36, Gordon Square, London W.C.1.

Applications close, in New Zealand and London, on 15th June, 1960. E9679

Classified Advts. continued on page 142

PUBLIC APPOINTMENTS

SOUTH WEST METROPOLITAN REGIONAL HOSPITAL BOARD

REGIONAL ENGINEER'S DEPARTMENT

Applications are invited for appointments on the permanent staff of the Board generally, in accordance with the Whitley Council conditions of service.

The Board is undertaking a considerable programme of hospital development and the persons appointed will be engaged on varied and interesting work.

ENGINEERING GENERAL GRADE

Applicants should be : (i) Corporate Members of the Institution of Mechanical Engineers and experienced in the preparation of specifications, drawings and estimates for large engineering installations in hospitals and large public buildings, or (ii) Corporate Members of the Institution of Heating and Ventilating, or (iii) have served a recognised engineering apprenticeship and be Graduate Members of the Institution of Mechanical Engineers, having passed A and B of the Associate Membership examination, or hold exempting qualifications. Sound experience of design of mechanical services of large buildings required. Drawing-office and Estimating experience an advantage.

Salary scale (on or after 1st July, 1960) : £910 by £35 (1) by £40 (2) by £45 (5) by £50 (7) to £1600 per annum. Bar at £1205 for Graduate members and at £1400 for Corporate members of the Institution of Heating and Ventilating. Corporate Members of the Institution of Mechanical Engineers commence at £1160 per annum, London Weighting allowance of £40–£50 per annum payable in addition.

Applications, stating age, qualifications, experience, present appointment and salary, together with the names and addresses of three referees, should be sent to the undersigned at 40, Eastbourne Terrace, London, W.2, by not later than 16th May.

E. G. BRAITHWAITE,
Secretary.

E9698

REPUBLIC OF IRAQ

CIVIL AND MECHANICAL ENGINEERS

The Directorate General of the Iraq Sewerage Board invites applications from suitably qualified Engineers for appointment to the following posts :

(1) CIVIL ENGINEER, to act as Deputy Resident Engineer on major sewerage schemes now under construction in Baghdad. Applicants should hold an Engineering Degree (or equivalent) and have had site experience of sewerage and sewage treatment works construction. Basic salary I.D.300 per month.

(2) MECHANICAL ENGINEER for site and office work in connection with drainage schemes in Iraq. Applicants should hold an Engineering Degree (or equivalent) and have had experience in the design, preparation of drawings and specifications, and checking of Tenders for the following mechanical plant of drainage schemes :

Full Sewage Treatment Works (Activated Sludge and Filtration Plants), Power Generating Plant, Vertical and Horizontal Sewage Pumps.

Applicants should also have had experience in the erecting, checking, operation and maintenance of the above equipment. Basic salary : I.D.250–270 per month.

The appointments will be for two years and will be subject to the standard Contract of Employment of non-Iraqi Officials, which may be seen at the address below. I.D.1 equals £1 sterling.

Application forms may be obtained from Messrs. John Taylor and Sons, Consulting Engineers, Artillery House, Artillery Row, London, S.W.1. Completed forms must be returned to Messrs. John Taylor and Sons at the above address by Wednesday, the 18th May, 1960. Applicants placed on the short list must be available for interview in London about the 24th May. E9611

CITY OF NOTTINGHAM

WATER DEPARTMENT

APPOINTMENT OF TWO CIVIL ENGINEERING ASSISTANTS

Applications for the above permanent, pensionable appointments are invited from Engineering Graduates and/or Corporate Members of the Institution of Civil Engineers with five years engineering experience which need not necessarily have been with a Water Undertaking. The Department has in hand a large programme of new works, offering considerable opportunities for gaining valuable experience. Salary, dependent upon qualifications and experience, in Grade A.P.T. IV, viz., £1065 by £55 by £50 (2) to £1220.

Applications, with names of two persons to whom reference may be made, to Engineer and General Manager, Water Department, Castle Boulevard, Nottingham, not later than the 23rd May, 1960.

T. J. OWEN,
Town Clerk.

The Guildhall,
Nottingham. E9696

MINISTRY OF TRANSPORT

CIVIL ENGINEERS

Ministry of Transport : CIVIL ENGINEERS. Pensionable posts for men and women at least 25 and under 35 on 1st January, 1960 (extension for regular Forces service, Overseas Civil Service, established Civil Service, and temporary Government service as Civil Engineer). Candidates must have achieved Corporate Membership of Institution of Civil Engineers or passed examinations necessary for attaining such membership. Experience in road and bridge construction essential ; knowledge of Highways Authorities' procedure desirable.

Starting salary (men, London) : from £830 to £1125, according to age. Scale maximum (London) : £1300. Promotion prospects.

Write : Civil Service Commission, 17, North Audley Street, London, W.1, for application form, quoting S/64/7. E9683

PUBLIC APPOINTMENTS

TRENT RIVER BOARD

APPOINTMENTS OF ASSISTANT ENGINEERS AND LAND SURVEYORS

Applications are invited for the following appointments in the Engineer's Department. N.J.C. service conditions with car allowance on "Essential User" Scale and Assisted Car Purchase Scheme is operated by the Board. The commencing salaries within the Grades mentioned below will be according to qualifications and experience, but normally appointments will be made in the lower half of the ranges.

Applications, including copies of testimonials or names of two referees to The Engineer, Trent River Board, 206, Derby Road, Nottingham, by 23rd May, 1960.

HEAD OFFICE, NOTTINGHAM.

(a) ASSISTANT ENGINEER I.

Salary : A.P.T. Grades III-V (£880–£1375).

The Engineer appointed will be engaged mainly on the design of major river improvement works and preference will be given to university graduates with previous experience of land drainage. A small house in Nottingham will be made available to the successful applicant on a rental basis.

(b) LAND SURVEYOR (Hydrology).

Salary : A.P.T. Grades I-III (£610–£1065).

The successful applicant will be engaged mainly on river gauging and surveys. Previous experience of river gauging is not essential as adequate training will be given.

DIVISIONAL OFFICES.

(c) THREE POSTS, one in each of the Divisional Offices at Tamworth, Nottingham and Gainsborough, and applicants should state their willingness to be appointed to all or any of these offices.

ASSISTANT ENGINEER II.

Salary : A.P.T. Grades I-III (£610—£1065), or Special Grade (£785–£1070).

The successful applicants will be engaged mainly on the design and supervision of river improvement schemes carried out by either contract or direct labour. Applications from University students who expect to graduate this year will also be considered.

DIVISIONAL OFFICE, TAMWORTH.

(d) LAND SURVEYOR.

Salary : A.P.T. Grades I-III (£610–£1065).

The successful applicant will be employed mainly in taking cross-sections of rivers and general topographical surveys.

IAN DRUMMOND,
Clerk of the Board.

E9622

BRITISH SHIPBUILDING RESEARCH ASSOCIATION

MARINE ENGINEERING SECTION

The British Shipbuilding Research Association has vacancies in the following two Grades in its Marine Engineering Section :

(a) GRADE B.—This Grade includes persons who have been assessed as having the ability to initiate, lead, and execute research. Qualifications required are a good University Degree in marine or mechanical engineering, and with practical training and experience. Research experience and/or service at sea an advantage. The salary will be within the range of £800 to £1600 per annum.

(b) GRADE C.—The Staff in this Grade are concerned with the conduct of the experimental side of investigations. Qualifications required are a Degree in marine or mechanical engineering, Higher National Certificate, or equivalent qualification. Apprenticeship or practical experience in engineering. Research and/or sea-going experience an advantage. The salary will be within the range of £725 to £1350 per annum.

The commencing salary for each appointment will, however, depend upon age and qualifications. All appointments are subject to the Federated Superannuation System for Universities.

Applications, with full particulars, should be addressed to B.S.R.A., 5, Chesterfield Gardens, Curzon Street, London, W.1. E9653

ROAD RESEARCH LABORATORY

(D.S.I.R.) HARMONDSWORTH, WEST DRAYTON, MIDDLESEX

ASSISTANT/EXPERIMENTAL OFFICER

Road Research Laboratory (D.S.I.R.), Harmondsworth, West Drayton, Middlesex, requires ASSISTANT/EXPERIMENTAL OFFICER for design and development of special purpose equipment, including necessary experimental work. Initiative and experience of design of scientific equipment, especially in field of applied physics, essential. Workshop experience desirable.

Qualifications : Pass Degree in Science or Engineering, or equivalent. A.E.O. age 22 or over, E.O. at least age 26.

Salary ranges : (Men) A.E.O., £570–£880 ; E.O., £1005–£1233.

Forms from Ministry of Labour, Technical and Scientific Register (K), 26, King Street, London, S.W.1 (quote Ref. A.84/OA). Closing date : 28th May, 1960. E9687

WAR OFFICE

DIDCOT, BERKS

TECHNICIAN

War Office requires TECHNICIAN at Didcot, Berks, to supervise staff engaged on inspection of a range of general stores, including hand tools, precision measuring equipment, fasteners, plumbing and hot water fittings, brass castings, &c.

Qualifications : Recognised apprenticeship and sound knowledge of the stores concerned ; ability to write concise and accurate technical reports ; O.N.C., C. and G. Final Certificates, or equivalent.

Salary : £680 (age 26) to £850 per annum.

Application forms from Manager (P.E.1371), Ministry of Labour, Professional and Executive Register, Atlantic House, Farringdon Street, London, E.C.4. E9686

PUBLIC APPOINTMENTS

SOUTH WEST METROPOLITAN REGIONAL HOSPITAL BOARD

PRINCIPAL ASSISTANT ENGINEERS II (HEATING AND VENTILATING) AND (ELECTRICAL)

Applications are invited for the above appointments on the permanent staff of the Board's Regional Engineer, generally in accordance with Whitley Council conditions of service.

The Board is undertaking a considerable programme of hospital development and the persons appointed will be engaged on varied and interesting work.

The commencing salary (on or after 1st July, 1960) will be at the minimum of the scale, £1665 by £50 (1) by £75 (2) by £85 (2) to £2035, plus London Weighting allowance of £50 per annum. Applicants must be Corporate Members of the Institutions of Mechanical or Electrical Engineers and should be experienced in the preparation of specifications, drawings and estimates for large engineering installations in hospitals and large public buildings.

Applications, stating age, qualifications, experience, present appointment and salary, together with the names and addresses of three referees, should be sent to the undersigned at 40, Eastbourne Terrace, London, W.2, by not later than 16th May.

E. G. BRAITHWAITE,
Secretary.

E9699

MINISTRY OF LABOUR

GOVERNMENT TRAINING CENTRE, GILL AVENUE, FISHPONDS, BRISTOL

ELECTRIC WELDER

ELECTRIC WELDER required by Ministry of Labour as INSTRUCTOR (unestablished) at the Government Training Centre, Gill Avenue, Fishponds, Bristol.

Applicants must be British subjects who are : (a) experienced and fully skilled ; (b) able to teach their trade ; (c) supervise the work and maintain control of trainees engaged in their trade. They should have undergone the training usual in their trade, followed by at least five years' practical experience. Applicants should preferably possess O.N.C. or C. and G. Certificate, or equivalent qualifications, where appropriate. Selected applicants will be required to pass a theoretical test before and a practical test after appointment.

Commencing salary (at age 28 or over) : £800, rising by annual increments to £925 per annum.

Application forms obtainable from Staff Section, South Western Regional Office, Ministry of Labour, Bridge House, Clifton Down, Bristol, 8, within seven days. E9685

MINISTRY OF AVIATION

ABERPORTH, CARDIGANSHIRE

TECHNICIAN

Ministry of Aviation requires TECHNICIAN at Aberporth, Cardiganshire, for maintenance and modifications to data-reduction equipment, including film readers, card-handling equipment and automatic typewriters and graph plotters.

Qualifications : Recognised engineering apprenticeship or equivalent training in an appropriate trade, O.N.C., C. and G. Final Certificate, or equivalent. Good electronic background with experience of both theoretical and practical work is essential. Housing may be available.

Salary : £680 (age 26) to £850 per annum.

Application forms from Manager (P.E.1499), Ministry of Labour, Professional and Executive Register, Atlantic House, Farringdon Street, London, E.C.4. E9693

MINISTRY OF AVIATION

WOOLWICH

TECHNICIAN

Ministry of Aviation requires a TECHNICIAN at Woolwich, to supervise staff engaged in manufacture of gauges and prototype equipment ; and manufacture of test rigs and aids to measurement used in conjunction with development projects.

Qualifications : Recognised engineering apprenticeship, O.N.C., C. and G. Final Certificate, or equivalent. Considerable experience of tool room work. Some knowledge of carpentry an advantage.

Salary : £720 (age 26) to £900 per annum.

Application forms from Manager (P.E.1498), Ministry of Labour, Professional and Executive Register, Atlantic House, Farringdon Street, London, E.C.4. E9694

LUTON WATER COMPANY

ENGINEERING ASSISTANT

The Company has a vacancy for a qualified ENGINEERING ASSISTANT at a commencing salary of £950 per annum, increasing to £1150 per annum by five annual instalments. In addition to normal expansion, a capital works programme of some £3,000,000 is anticipated over the next 5-6 years. The position is permanent, with pension and life assurance scheme, and a large flat at moderate rental is immediately available. Applications, giving full personal details, qualifications and experience, together with names of two persons to whom references may be made, should be received by the undersigned by May 31st, 1960.

A. J. WATKINS, M.I.C.E.,
Engineer and Manager.

Luton Water Company,
Crescent Road,
Luton, Beds. E9669

PUBLIC APPOINTMENTS

SUNDERLAND AND SOUTH SHIELDS WATER COMPANY

ASSISTANT ENGINEERS—DERWENT SCHEME

Applications are invited for the temporary appointment of TWO ASSISTANT ENGINEERS in the New Works Department of the Company. The successful applicants will primarily be concerned with the design and construction of the Mosswood Treatment Works, which will have a capacity of 32 m.g.d. It is anticipated that the duration of the appointments will be at least four years and the commencing salaries will, according to qualifications and experience, be as follows :

1. Not less than £1500 per annum.
2. Within the range £1175 to £1325 per annum.

Candidates should be Associate Members of the Institution of Civil Engineers or Structural Engineers, or in the case of the second appointment have passed the equivalent examinations. The appointments call for a sound knowledge of building and structural design and construction, and experience in these fields in relation to Waterworks practice would be an advantage.

Arrangements can be made for the successful applicants to become or to continue as members of a Local Government superannuation scheme during their service with the Company.

Applications, giving full personal particulars and details of qualifications and experience, together with the names of two persons to whom reference may be made, should be received by me not later than 30th May, 1960.

A. G. McLELLAN,
General Manager.

29, John Street,
Sunderland. E9718

TYNE IMPROVEMENT COMMISSION

CIVIL ENGINEERS

The Tyne Improvement Commissioners invite applications from CIVIL ENGINEERS for appointments at Senior and Junior levels on their Technical Staff.

The River Tyne is one of the major ports of the United Kingdom and the Tyne Commissioners' Undertaking affords excellent opportunities for interesting work associated with the execution and maintenance of extensive Dock and Harbour Engineering Works.

Applicants for senior appointments must be Chartered Civil Engineers and experience in the design of new works would be an added qualification.

Salaries will be related to the qualifications and experience of successful candidates and within a range up to £1450 per annum.

The appointments are superannuable and subject to the passing of a medical examination.

Applications, stating age, education, training, qualifications and details of experience, and giving the names and addresses of two referees as to training and experience, should reach the undersigned not later than the 31st May, 1960.

R. N. EGGLETON,
Secretary.

Bewick Street,
Newcastle upon Tyne, 1.
1st May, 1960. E9726

TENDERS

BOROUGH OF CAERNARVON

ABER BRIDGE RECONSTRUCTION

TENDERS are invited from firms experienced in bridge reconstruction for the STRENGTHENING and IMPROVEMENT of ABER SWING BRIDGE and the Approach Roads to the Bridge. The bridge, which is of steel construction, carries one line of road traffic and is about 250ft. long, the swing span being about 150ft. long.

The works include the replacement and strengthening by welding of certain bridge members, the provision of timber footways, steel road deck and macadam surfacing, the replacement in cast iron of the roller paths and rollers, alterations to the operating mechanisms and the improvement of the approach roads.

Instructions to persons Tendering and documents may be obtained from the Consulting Engineers, F. R. Bullen and Partners, Dacre House, Dean Farrar Street, Westminster, S.W.1, on payment of £5 5s. deposit, returnable upon receipt of a bona fide Tender.

Applications for Tender documents should be made to the Consulting Engineers by 10th May, 1960.

On and after 2nd May, 1960, drawings may be inspected at the offices of the Borough Engineer and Surveyor, Swyddfa'r Dref, High Street, Caernarvon, or at the offices of F. R. Bullen and Partners, either in London or at 42, Victoria Road, Darlington, Co. Durham, without payment.

Tenders are to be delivered to the undersigned in a plain, sealed envelope before 12 o'clock noon on 14th June, 1960.

J. O. SMITH,
Town Clerk, Borough of Caernarvon.

Town Clerk's Office,
Briggs Chambers,
Caernarvon. E9613

HEAVY ELECTRICALS, LIMITED, BHOPAL, INDIA

Invite TENDER No. PP/F/MT/60/5 for the SUPPLY of BORING MACHINES, LATHES, SHEARS, PRESSES, &c.

Tender Forms and Specifications can be obtained from Heavy Electricals, Limited, Crown House, Aldwych, London, W.C.2, on payment of £2 5s. per set. The Tender is to be returned to Heavy Electricals, Limited, Post Box No. 46, Bhopal, India, so as to reach them by the 20th July, 1960. E9712

TENDERS

INDIA SUPPLY MISSION

The Office of India Supply Mission, 2536, Massachusetts Avenue, N.W. Washington 8, D.C., United States of America, invites TENDER for the following :

TENDER ENQUIRY No. SE.165.

For the SUPPLY of CRAWLER TRACTORS, MOTORISED SCRAPERS, EXCAVATORS, REAR DUMPERS and WELDING SETS for the Khadakwasla Project, Bombay.

Tender documents, &c., relative to the above can be obtained from the Co-ordination Branch, India Store Department, Bromyard Avenue, Acton, London, W.3, at a cost of 21 shillings and sixpence per Tender, and is not refundable. Tenders are to be returned direct to India Supply Mission, 2536, Massachusetts Avenue, N.W. Washington 8, D.C., United States of America, so as to reach them by the 21 June, 1960.

Specimen copy of the above enquiry can be seen at India Store Department, Vehicles Branch, Bromyard Avenue, Acton, W.3, under the following reference :

S.4821/59/HEA/VEH. E9716

TENDERS

INDIA STORE DEPARTMENT

TWELVE RADIATION TYPE RECUPERATORS

The Office of the Director General, India Store Department, Government Building, Bromyard Avenue, Acton, London, W.3, invites TENDERS for the following :

For the SUPPLY of TWELVE RADIATION TYPE RECUPERATORS, required for furnace operating temperature of 1350 deg. Cent.

Specification, &c., can be obtained from the Co-ordination Branch, India Store Department, Bromyard Avenue, Acton, W.3, at a cost of 10 shillings per tender. The Tenders are due to be returned to India Store Department, at the above address, so as to reach them by 2 p.m. on Thursday, 9th June, 1960.

Specimen copy of the above Specification can be seen at Engineering Branch, India Store Department, Acton, W.3, under the following reference : 2061/59/ENG.2. E9660

BOOKS and PUBLICATIONS

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TENDERS

COQUET WATER BOARD

NORTHERN TRUNK MAIN

CONTRACT NO. 6

THE COQUET WATER BOARD invite TENDERS for the LAYING of :

11,340 lin. ft. or thereabouts of 18in. STEEL PIPES.

19,280 lin. ft. or thereabouts of 16in. STEEL PIPES.

13,140 lin. ft. or thereabouts of 9in. STEEL PIPES.

42,340 lin. ft. or thereabouts of 12in. SPUN IRON PIPES.

29,275 lin. ft. or thereabouts of 9in. SPUN IRON PIPES.

1500 lin. ft. or thereabouts of 6in. SPUN IRON PIPES.

1800 lin. ft. or thereabouts of 3in. SPUN IRON PIPES.

Together with SPECIAL PIPES, FITTINGS and the CONSTRUCTION of ANCILLARY WORKS.

The Works are situated in the County of Northumberland, commencing at Warkworth in the rural district of Alnwick and terminating at Windy Law in the rural district of Belford.

Tender documents may be obtained from Mr. S. G. Barrett, Engineer and Manager of the Coquet Water Board, P.O. Box 104, Pilgrim Street, Newcastle upon Tyne, 1, on the payment of a deposit of five guineas which will be returned on the receipt of a bona fide Tender not subsequently withdrawn and the return of all documents. (Cheques should be made payable to The Coquet Water Board.)

Tenders should be returned to the undersigned in the envelope provided which should not bear any mark identifying the sender, not later than 10 a.m. on the 17th June, 1960.

The Board are not bound to accept the lowest or any Tender.

F. G. EGNER,
Clerk and Solicitor to the Board.

14, Northumberland Square,
North Shields. E9701

COUNTY COUNCIL OF ESSEX

(1) "Poplars," Hostel for Elderly Persons, Walton-on-Naze. CONVERSION TO OIL FIRING.

(2) "Westwood Park," Hostel for Elderly Persons, Little Horkesley. PROVISION OF NEW OIL-FIRED HEATING APPARATUS.

Contractors wishing to submit firm price Tenders for the above should forward their names, from which panels will be chosen and provided with Tender documents.

(1) Conversion of existing heating apparatus to oil-firing, estimated cost £2600. The work is to be completed by mid-September, 1960.

(2) Provision of new oil-fired central heating apparatus to whole building, estimated cost £8500.

Separate applications for each contract to reach the undersigned not later than 14th May, 1960.

H. CONOLLY, C.B.E., F.R.I.B.A.,
County Architect.

County Hall,
Chelmsford. E9728

EDUCATIONAL

UNIVERSITY OF LONDON KING'S COLLEGE

TUTORIAL STUDENTSHIP IN MECHANICAL ENGINEERING

A TUTORIAL STUDENTSHIP is offered in the Department of Mechanical Engineering. The value is £425 a year, with free tuition, from 1st October, 1960. Applicants must be graduates or about to graduate, and will be required to read for a higher degree, and to give a limited amount of assistance by demonstrating.

The successful applicant will be expected to take part, under supervision, in research in Refrigeration.

Particulars and forms from the Registrar, King's College, Strand, W.C.2, whom completed applications should reach not later than May 20. E9584 E

UNIVERSITY OF LONDON KING'S COLLEGE

SHELL STUDENTSHIPS IN CHEMICAL ENGINEERING

Value £375 each, plus tuition fees. May be held for the one-year postgraduate course for the College Diploma in Chemical Engineering, or for the first year (with possible renewal) of higher degree work.

Applications are invited from graduates in Chemistry or Engineering. Forms must be obtained from the Registrar, King's College, Strand, London, W.C.2, and must reach him completed by May 26th, 1960. E9583 E

A.M.I.MECH.E., B.Sc., City and Guilds, &c. Guarantee Postal Courses for all Exams. and Technical Divisions from Elementary to Degree standard including Automation Techniques. Approximately 95 per cent. successes. 148-page prospectus, free on request.—B.I.E.T. (Dept. 22), 29, Wright's Lane, London, W.8. E114 E

SITUATIONS VACANT

APPLICANTS ARE ADVISED TO SEND COPIES NOT ORIGINALS OF THEIR TESTIMONIALS UNLESS OTHERWISE REQUESTED.

ADHESIVE TAPES, LTD., manufacturers of Sellotape Brand Pressure Sensitive Products, require an additional ENGINEER of B.Sc. or H.N.C. qualifications with the right personality to make use of a wide training in their operations. Maximum age 30 years. The position would suit an Engineer who wishes to use a sound technical background as a basis for a career in industry which will call for versatility, self-reliance and the ability to get things done. Superannuation scheme. Salary will be assessed on age and experience.—Apply, giving full particulars, to Personnel Manager, Adhesive Tapes, Ltd., Boreham Wood, Herts. E9715 A

Classified Advts. continued on page 144

COMPANY MEETING

THE HOFFMANN MANUFACTURING COMPANY

RECORD TURNOVER ACHIEVED

The annual general meeting of The Hoffmann Manufacturing Company, Ltd., was held on May 4 in London, Mr. J. W. Garton, J.P. (chairman and managing director), presiding.

The following is an extract from the statement by the chairman which had been circulated with the report and accounts for the year ended December 31, 1959 :

In the year 1959 which is now under review we achieved a record turnover consequent upon a marked improvement in the order position from the middle of the year onwards.

I have pointed out before that the Company's trade is broadly based and our prosperity is a reflection of the level of activity of the country's engineering trade as a whole.

The order book at this time is in a very healthy state, but I would personally wish to see increased investment in capital equipment, and whilst there is some indication of this trend the emphasis would still appear to be mainly on consumer goods.

The profit of the Hoffmann Group for 1959, before taxation, but after all other charges, including Debenture Interest, amounts to £1,704,511 and compares with £1,206,476 for the previous year. Income Tax and Profits Tax absorb £717,340 against £581,474 in 1958. The net profit of the Group for the year 1959, after taxation is, therefore, £987,171 and compares with £625,002 for 1958.

The question of the Ordinary Dividend has again been given careful consideration by the Directors, and they recommend a Final Dividend of 29½ per cent, less tax, which with the Interim Dividend already paid of 6½ per cent., less tax, makes a total dividend of 36 per cent., less tax, for the year, and compares with a total dividend of 31 per cent., less tax, for 1958, when, however, a special 60th Anniversary Cash Bonus of 5 per cent., less tax, was also paid.

The Directors have had pleasure in granting a sum of £55,000 to the Group Benevolent Funds to provide extra pensions to retiring employees, and this amount is being contributed as to £50,000 by the parent company and £5,000 by Hoffmann Gloucester, Ltd., and these allocations will ensure the benefits we originally intended.

The Fixed Assets Replacement Reserve of the Group has been increased by a transfer of £375,000 which brings the Reserve to £2,650,000. I refer later to the Board's proposals regarding the use of part of this Reserve.

A transfer of £250,000 has been made to the Group General Reserve which now totals £1,100,000.

Capital Expenditure

The Group Capital Commitment for plant and machinery at the 31st December, 1959, amounted to £1,189,683, and the major part of this new equipment will be installed by the middle of the current year. This substantial expenditure has been made necessary by the increasing demand for our products, involving the extension of our production facilities in both factories, coupled with the Board's policy of continually keeping the manufacturing plant up to date by the employment of the most modern machine tools.

This capital programme will be financed from the internal resources of the Group.

The Directors give continuous attention to the repairing and maintenance of the buildings, plant and machinery.

The excess of Current Assets over Current Liabilities at the close of 1959 amounted to £4,814,473 compared with £4,192,972 at the close of 1958.

Subsidiary and Associated Companies

Hoffmann Gloucester, Ltd., has again had a very good year, and continues to play an important part in the Group's activities, with its combination of special bearings and standard group products.

Hoffmann Tweedales, Ltd., again experienced unsatisfactory trading conditions due to the reduced demand for its products by the textile machinery trade, but the position may improve later this year as a result of marketing new products which have been recently developed and which are now undergoing tests.

Capital Reorganisation

At the 31st December, 1959, the Parent Company's Fixed Assets Replacement Reserve stood at £2,000,000 and the Directors consider that in view of the considerable amount already spent on capital equipment, it would now be prudent to capitalise part of this Reserve, the balance remaining on the Reserve Account being ample cover for that part of the outstanding capital expenditure commitment of the Parent Company at the 31st December, 1959, of £718,751, which relates to increased cost of replacement.

The Directors still feel that the issued share capital does not adequately reflect the capital actually employed in the Company's business and they therefore propose that the sum of £1,000,000 part of the amount standing to the credit of the Parent Company's Fixed Assets Replacement Reserve, be capitalised and distributed amongst the Ordinary Shareholders in the form of one new Ordinary Share for every existing Ordinary Share.

I should like to emphasise that this does not imply any intention to increase the amount distributed to the Ordinary Shareholders for 1960.

The report and accounts were adopted.

At the subsequent extraordinary general meeting the Board's capital proposals were duly sanctioned.

SITUATIONS VACANT

A QUALIFIED METALLURGIST is required, to assist in the technical and commercial development of a new Division concentrating on metal joining and treatment processes in an expanding Company in North East England. The successful applicant, preferably in the age group 30/40, for whom future opportunities for advancement are excellent, will have an extensive theoretical and practical knowledge of Metallography and a general knowledge of Physics. He will also have had research experience and be generally acquainted with the practical application of his subject to light mechanical or electrical engineering and sheet metal fabrication, combined with an ability for analytical discussion of complex problems with managements, consultants or research organisations. A high starting salary commensurate with the importance of the position will be paid. Pension and other benefits. Write in confidence, giving full particulars.—BOX No. E9723, "The Engineer." A

ASSISTANT CIVIL ENGINEER
Required by Westminster Consultants for design side. Post covers interesting work on home and overseas jobs on water supply and drainage. Age range, say, to 28. A.M.I.C.E. desirable, but I and II or H.N.C. standard certainly considered. Please indicate qualifications and experience.—BOX No. E9676, "The Engineer." A

ASSISTANT ELECTRICAL ENGINEER required for a group of brick works in the Peterborough area. Applications are invited from men, aged 35 to 40 years, who have served an apprenticeship and hold at least H.N.C. in Electrical Engineering. Applicants should have first-hand experience of installations for power and lighting; E.H.T. and M.V. distribution and the operation and maintenance of works and quarry plant.—Apply, stating salary required, to the Personnel Manager, London Brick Company Limited, Stewartby, Bedford. E9657 A

ASSISTANT ENGINEER—in East Africa, for English Public Company. Age 27–34, full apprenticeship in general engineering, qualifications to at least H.N.C., and sound practical experience of civil, mechanical and electrical engineering. Remuneration dependent on age and qualifications but not less than £1000 per annum, plus free accommodation, paid home leave and passages, free medical, contributory provident fund, &c.—Write fullest particulars and copy references to BOX A.E.D. 965, c/o Streets, 110, Old Broad Street, E.C.2. E9719 A

ASSISTANT MECHANICAL ENGINEER
A vacancy exists for the above post which is located in Birmingham.

The person appointed will be required to assist the Mechanical Engineer in the maintenance work on gas works plant and the installation of new plant. Candidates should have served an apprenticeship in engineering and have had further experience in general engineering and steam plant. Some knowledge of mechanical handling and of incentive schemes based on Work Study as applied to maintenance work will be an advantage. Possession of an Engineering Degree, Corporate Membership of the Institution of Mechanical Engineers, a Higher National Certificate in Mechanical Engineering or equivalent qualification is essential.

The salary for the appointment, which is pensionable and subject to medical examination, will be within the range of £1006–£1131 per annum.

Applications, stating age, training, qualifications and experience, together with the names of two referees, should be addressed to Mr. J. E. Wakeford, Divisional General Manager, West Midlands Gas Board, Edmund Street, Birmingham, 3, to reach him not later than the 16th May, 1960. E9713 A

B. O. MORRIS LIMITED,
ALBION WORKS,
465, COMMERCIAL ROAD,
PORTSMOUTH
require
TWO SENIOR MECHANICAL ENGINEERING DRAUGHTSMEN preferably with Machine Tool Experience and Technical Qualifications at least to O.N.C. The work comprises Structural, Mechanical and Jig and Fixture Design mainly for the Atomic Energy Authority. Please write full details.

E9663 A

BP invites applications from GRADUATES aged 23-26 years with an honours degree in Petroleum Engineering, Engineering or Physics for employment as Assistant Production Engineers in Trinidad in the first instance. Duties will consist of assisting in all aspects of field production work, including well control, artificial lift, gas control, oil collection and well servicing. National Service obligations must have been fulfilled.—Write, stating age and full details of qualifications and experience, quoting F.574A, to BOX 3251, c/o 191, Gresham House, E.C.2. E9705 A

DESIGN ENGINEERS
are required by the United Kingdom Atomic Energy Authority at Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland, to assist in the programme of research and development designed to study the behaviour of fuels and materials used in the construction of nuclear power stations. There are a number of these posts covering the following duties :—

(a) Commissioning and testing of approved experimental rigs and equipment to ensure their integrity before placing in the reactor.
(b) Development of engineering components and prototype rigs.

Candidates must have served a recognised engineering apprenticeship and be Corporate Members of a Senior Engineering Institution or have an Honours Degree in Engineering and at least three years' industrial or research experience.

Salary between £860 (at age 25) and £1340.
Contributory superannuation. Staff housing scheme.
Hostel accommodation available.
Send postcard for application form, quoting reference 244/J.1, to Personnel Manager at above address.
Closing Date : 16th May, 1960. E9645 A

BP requires PETROLEUM ENGINEERS for overseas service in its Exploration Department. Applicants, aged between 21-27, must possess an Honours Degree in Physics, Mechanical Engineering or Petroleum Engineering. Previous oilfield experience would be an advantage. Salary according to age, qualifications and experience. National Service obligations must have been fulfilled.—Write, stating age and full details of qualifications and experience, quoting F.579, to BOX 3254, c/o 191, Gresham House, E.C.2. E9706 A

CIVIL ENGINEERS
Merz and McLellan require Senior and Junior Civil Engineers for design work at Newcastle upon Tyne. The appointments are permanent, pensionable positions and are concerned with a variety of very heavy Civil Engineering construction works. Applications by letter in the first instance, bearing reference SAR, should be sent to Merz and McLellan, Carliol House, Newcastle upon Tyne, 1. E9651 A

DESIGN ENGINEERS AND DESIGNER DRAUGHTSMEN
with up to eight year's experience in design of Reinforced Concrete and Steel Structures in connection with Power Stations, Tunnels and Railway work. Apply : giving details of experience to :
SIR WILLIAM HALCROW & PARTNERS,
ALLIANCE HOUSE, CAXTON STREET,
LONDON, S.W.1.

E9599 A

DESIGNER—STEELWORK
required by professional firm, Central London. Experience desirable in light and heavy construction work—determinate and indeterminate (rigid frames)—for industrial installations. More than one post available and salary necessarily to be agreed according to technical education and experience. Please give details of education, any qualifications, and experience, —BOX No. E9721, "The Engineer." A

DRAUGHTSMAN—MECHANICAL
interested in wide variety of industrial plants and design process services, required by Westminster consultants who are extending staff. Age, say, 25–35, and salary would be considered in relation to education and experience. Details of these, please, to BOX No. E9720, "The Engineer." A

DRAUGHTSMAN required for Mechanical Engineering Department, Dagenham Dock. Experience in pipe work for bulk oil installations or equipment for mechanical handling advantageous. Age over 25. Shop experience, O.N.C. or H.N.C. are requirements. Salary above A.E.S.D., Pension Fund, Canteen and Bonus.—Apply Personnel Manager, Samuel Williams and Sons, Limited, Dagenham Dock, Essex. E9695 A

DRAUGHTSMAN
A large Engineering Company in the Sheffield area has a vacancy for a Draughtsman aged between 23-30 years, and experienced in general mechanical engineering. The possession of an O.N.C. in Mechanical Engineering is essential, and the H.N.C. would be an added advantage.
Working conditions are excellent—full welfare and recreational facilities—good pension scheme.
Please write, giving full details of age, education, qualifications and experience to BOX D.950, c/o Streets, 110, Old Broad Street, E.C.2.

E9712 A

DRAUGHTSMEN required by Engineering Company in WEMBLEY (near North Circular Road). Experience on water tube boilers and boiler plant generally desirable but not essential. Excellent working conditions. 5-day week. Staff bonus and pension scheme in operation. Three weeks' holiday after two years' service. Salary according to age and experience.—Write immediately to the Chief Draughtsman, LA MONT STEAM GENERATOR LIMITED, Heather Park Drive, Wembley, Middlesex, or telephone WEMbley 8821 for appointment. E9674 A

DRAUGHTSMEN
The following vacancies have occurred at Etruria Gas Works, Stoke-on-Trent :

1 post within the range of £733–£813 per annum.

1 post within the range of £629–£709 per annum.

Candidates for the first post should hold an appropriate Higher National Certificate and have considerable experience in an engineering drawing-office, whilst candidates for the second should possess an appropriate Ordinary National Certificate and have completed a drawing-office apprenticeship or have equivalent experience.

The posts are pensionable and the persons appointed may be required to pass a medical examination.

Applications, stating age, qualifications, experience, and the post required, should be addressed to Mr. L. W. Johnson, Divisional General Manager, West Midlands Gas Board, Etruria Gas Works, Stoke-on-Trent, Staffs., to reach him not later than the 16th May, 1960. E9714 A

ENGINEER-DRAUGHTSMAN with light press tool experience on mass production of aluminium foil products. Time served man with design experience and higher technical education at least to H.N.C. Age preferably 30 to 45. Based in London area.—Applications, with full particulars of education, training and experience, with salary expected, to BOX No. E2813, "The Engineer." A

ENGINEERS FOR TECHNICAL ENGINEERING DEPARTMENT.—Duties include the preparation of mechanical/thermal schemes for power plant and allied projects. A good knowledge of basic thermodynamics, hydraulics and kindred subjects is essential. Experience in one or more of the following would be an advantage—(a) boiler design, (b) heat exchanger design, (c) gas turbine applications. The successful candidate will be centred in London, but will be expected to undertake short visits to site as required.—Applications, giving details of training, qualifications and experience, should be sent to Personnel Department, Ewbank and Partners, 10-11, Grosvenor Place, London, S.W.1. E9697 A

FORD OF DAGENHAM
require
DESIGN DRAUGHTSMAN : age 24–40.
Experience of machine tool or special purpose machinery essential. H.N.C. standard with good knowledge of pneumatics and hydraulics an advantage.
Apply to Mr. G. McGuire, Training and Recruitment Department, Ford Motor Company Limited, Dagenham, Essex, quoting reference LDD. E9675 A

FOSTER WHEELER LIMITED
require a
VESSEL ENGINEER

for one of their Specialist Groups. Applicants should have at least four years' experience in the design of pressure vessels and tanks, and should be fully conversant with relevant American design codes. Some experience in the manufacture of pressure vessels is desirable, but not essential.

Applicants should apply in writing, giving a brief statement of age, qualifications and experience, to the Staff Manager, 3, Ixworth Place, London, S.W.3.

E9717 A

INDUSTRIAL FURNACE CONSTRUCTION COMPANY, engaged principally in Iron and Steel Industry on construction of Open Hearth Steel Furnaces, Soaking Pits, Rotary and Annealing Furnaces, &c., and Blast Furnace linings, require the following staff.
SITE ENGINEERS. Age 30 to 40 years.
JUNIOR SITE ENGINEERS. Age 23 to 30 years.
Applicants should preferably be qualified engineers with iron and steelworks experience, but Engineers with sound practical experience will be considered. These are permanent appointments with participation in pension scheme after probationary period. Salary commensurate with qualifications and experience, plus bonus. Applications, giving personal details, qualifications and experience.—BOX No. E9639, "The Engineer." A

JUNIOR MECHANICAL / ELECTRICAL ENGINEER required by Consulting Engineers specialising in Water Supply and Main Drainage work. Salary up to £950 per annum. Five-day week. Luncheon vouchers and superannuation schemes.—Apply, HOWARD HUMPHREYS AND SONS, Victoria Station House, Victoria Street, Westminster, S.W.1. Please quote Ref. 398. E2825 A

PLANT LAYOUT DRAUGHTSMAN required for Rolling Mill and ancillary plant development work. Must be trained to H.N.C. standard, and have experience in above or heavy engineering trade. —Write in first instance, giving full particulars of education, age, training and experience, with salary expected, to Invicta Foil Company, Limited (part of the Impalco organisation), Alfreds Way, Barking By-Pass, Barking, Essex. E2823 A

PORT OF MANCHESTER
ASSISTANT TO MECHANICAL ENGINEER
The Manchester Ship Canal Company have a vacancy for an Assistant to the Mechanical Engineer. Applications for the position which will carry good prospects of promotion, are invited from candidates who should not be more than 35 years of age, preferably holding a University Degree in Mechanical Engineering or other suitable qualification, and with practical experience in a position of responsibility. The salary offered will be in accordance with qualifications and experience. The successful candidate will be required to pass a medical examination and to become a member of the Company's contributory superannuation scheme.
Applications, containing full particulars of age, education, qualifications and experience, should be addressed to the Mechanical Engineer, Manchester Ship Canal Company, Ship Canal House, King Street, Manchester, 2, not later than 31st May, 1960. Envelopes should be marked "A.M.E. PERSONAL." E9652 A

SALES ENGINEERS. For various areas. Competent men with experience of foundry drying stoves and ancillary equipment, heat-treatment furnaces and sand plants. Must have established contacts. Knowledge of oven and furnace construction an asset. Required by very well-known Midland manufacturers. Fullest support given to successful applicants. Write in first instance.—BOX No. E2827, "The Engineer." A

SITE ENGINEER required by well-known firm manufacturing a wide range of Mining, Roadmaking and Quarry Plant. Must be capable of directing all aspects of plant erection and controlling labour.—Full details of experience, age, salary required and when available. BOX No. E9692, "The Engineer." A

POWER STATION CHEMIST
ELECTRICITY DEPT.,
CAPE TOWN, SOUTH AFRICA
A vacancy exists in the Generation Branch of the Electricity Department of the city Council of Cape Town, South Africa, for a suitable qualified person for the position of Power Station Chemist.
The scale of pay (total emoluments) applicable to the post is £1560, with two increments of £60 to a maximum of £1680 per annum.
Applicants must possess a Degree in Chemistry of a recognised University or an equivalent qualification. They must have had experience in a power station laboratory and be familiar with the methods of sampling and analysis of materials used in a Power Station, preferably with advanced steam conditions. A knowledge of nuclear physics and the use of radio-active isotopes will be an advantage.
Persons possessing the requisite qualifications and experience are invited to apply not later than MONDAY, 23RD MAY, 1960, and to address their applications to :—
Messrs. Merz and McLellan,
Carliol House,
Newcastle upon Tyne,
ENGLAND,
from whom further particulars relating to the vacant position may be obtained.

E9650 A

TENDER AND CONTRACT ENGINEERS
In order to meet increasingly heavy commitments arising from our activities in the industrial gas cleaning field, further appointments of staff are to be made.
The duties, which are extremely varied, would include the preparation of Tenders for major gas cleaning installations (including all ancillary plant) particularly in the steel industry, and/or the execution of contracts resulting therefrom.
Excellent prospects are open to candidates having suitable qualifications and experience in the mechanical and/or electrical engineering fields, and who are seeking a position where initiative and an ability to operate with the minimum of policy supervision are prime requisites. Some knowledge of, and experience in, industrial gas cleaning is desirable but not essential.
Superannuation and other benefits, salary by arrangement. Age group : 25-40.
Applications for interview, stating qualifications and past experience, should be made in writing to W. C. Holmes and Co., Ltd., P.O. BOX No. B.7, Turnbridge, Huddersfield, marked G.C.D.

E9727 A

THE BRITISH STEEL CASTINGS RESEARCH ASSOCIATION, East Bank Road, Sheffield, 2, requires a versatile qualified MECHANICAL ENGINEER (Graduate or A.M.I.Mech.E.) as a Senior Investigator in the Plant Engineering Section. Progressive salary in range £750–£1500 per annum, depending on age, qualifications and experience. Superannuation scheme. 3 weeks' annual leave. Duties will comprise applied research and development relating to plant and equipment used in steel foundries both at the Association's headquarters in Sheffield and in the works of member companies. —Applications, which would be especially welcome from candidates with industrial and research and development experience, should be made to the Director. E9655 A

WANTED, FIRST-CLASS SENIOR DESIGN DRAUGHTSMAN for firm of General Engineers in Bristol. Good knowledge of general engineering, with particular reference to pressure vessels and stainless steel fabrication. This will be a well-paid position for the top-class man.—BOX No. E164, "The Engineer." A

WORKS ENGINEER with good knowledge of Plant and Electrical maintenance for up-to-date Leeds Works, including Mechanised Foundries. Salary around £1000 p.a., depending on qualifications and experience. House can be made available. Give full career.—BOX No. E9722, "The Engineer."

PLATT BROS. & CO., LTD., OLDHAM,
require a
SENIOR DRAUGHTSMAN
with experience of Machine Design, H.N.C. qualification,
and a
JUNIOR DRAUGHTSMAN
with experience of Machine Design, O.N.C. qualification.

Experience of Textile Machinery would be an advantage but not essential.

Salary commensurate with qualifications and experience.

Apply by letter or in person to the Personnel Manager, Arkwright Street, Oldham.

E9682 A

SITUATIONS VACANT

MACHINE TOOL PRODUCTION MANAGER

required for

KENDALL & GENT, LIMITED
(Associated with W. E. Sykes, Limited)
MANCHESTER

A highly qualified engineer is required for appointment as Production Manager of this leading manufacturer of plano-milling, vertical milling and other machine tools.

Applicants must have had experience in the production of large machine tools of a high standard or comparable experience in heavy engineering.

This is an important post for a man with works managerial ability and will be remunerated by a high salary with pension rights. The preferred age range is 35/45.

Send full details of qualifications, present and previous employment, age and other personal information, marked confidential, to the

SECRETARY, KENDALL & GENT LIMITED, VICTORIA WORKS, MANCHESTER, 18.

E2824 A

MACHINE SHOP MANAGER

for a young expanding company of precision engineers near Manchester, employing approximately 250 people. Starting salary about £1500 per annum, plus bonus and pension scheme. There are excellent prospects of considerable status and salary advancement within the next few years. Preferred age 30-40.

The Machine Shop Manager will be responsible to the General Manager and will control the Machine Shop and the Development Section. The number of components processed by the Company has increased very rapidly, and one of the Machine Shop Manager's initial functions will be to assist in the implementation of a production planning and control system. Considerable developments for the Company are planned in the near future, and the Machine Shop Manager's responsibilities will increase accordingly.

The main requirements for this appointment are a professional qualification (preferably A.M.I.Mech.E.), several years' production experience in precision engineering, plus sound operational knowledge of production planning and work study. Some knowledge of electronic control devices would be an advantage.

Please write briefly in the first instance, quoting Reference No. 682, to :

AA LTD

ASHLEY ASSOCIATES LTD.
PETER HOUSE, MANCHESTER 1.
RETAINED TO ADVISE ON THIS APPOINTMENT
The strictest confidence will be observed and no details of candidates will be passed to clients without candidates' permission.

E9680 A

SITUATIONS VACANT

JOHN SUMMERS & SONS LIMITED

HAWARDEN BRIDGE STEELWORKS
SHOTTON · CHESTER

require . . .

1. **A BUILDING DEPT. MANAGER** (Age 35-50)
2. **AN ASSISTANT MANAGER— GENERAL ENGINEERING DEPT.** (Age 35-45)
3. **A COKE OVENS ENGINEER** (Age 30-40)
4. **AN ASSISTANT MECHANICAL ENGINEER** (Age 30-40)

Academic qualifications of Degree or H.N.C. standard combined with practical experience in medium/heavy engineering essential.

APPLICATIONS, IN CONFIDENCE, TO THE ABOVE ADDRESS UNDER REF. R.L.W./E.N.G.

E9608 A

ROAN ANTELOPE COPPER MINES LIMITED

NORTHERN RHODESIA

ELECTRICAL ENGINEER

This is a senior appointment and entails full responsibility to the Company's Resident Engineer for all electrical engineering matters.

The Company's activities are extensive, consisting of the mining and milling of approximately 6 million tons of ore per year and a smelter production of approximately 90 thousand tons of copper per year. The Company also operates certain ancillaries, including two townships and two hospitals for European and African employees. Power consumption is over 220 million units per year, with a peak load of 34 thousand kW., and is supplied partly from the Company's own thermal generating station and partly from the Copperbelt 66 kV. grid system which is fed from the Kariba Hydro-Electric Scheme.

The initial basic salary which will be in excess of £2000 per annum will be commensurate with qualifications and experience. In addition to basic salary there is a cost-of-living allowance currently £6 10s. 0d. per month. There is also a variable bonus which, at the present time, is 39 per cent. of basic salary. The successful candidate will be required to join the Company's Pension and Life Assurance Scheme. Employees contribute 5 per cent. of basic earnings, and the Company contributes 5 per cent. for the first year, increasing its contribution by ½ per cent. for each completed year of service. There is also a contributory Medical Benefit Scheme.

Leave at the rate of 55 days per annum may be accumulated over a period of 3 years. Passage fares to Northern Rhodesia will be paid for the employee and his family.

Accommodation in a large three-bedroomed house is available on engagement at a sub-economic rental.

Applicants, who should have a Degree or equivalent qualification in Electrical Engineering, be Corporate Members of the Institution of Electrical Engineers, and also have had previous experience in heavy engineering and labour relations, should send particulars of age, qualifications and experience, in confidence, to :—

D. J. Beake, Selection Trust Building,
Mason's Avenue, Coleman Street, London, E.C.2

E9664 A

Classified Advts. continued on page 146

SITUATIONS VACANT

JOSHUA TETLEY & SON, LTD.

ENGINEER FOR BOTTLING PRODUCTION

Applications are invited for appointment as Assistant Bottling Stores Manager at the Company's Brewery at Leeds.

The successful candidate will be responsible to the Store Manager for the day-to-day operation of a modern plant bottling the Company's beers, and for developing the potentialities of this plant to the full. His qualifications will include experience of production management, not necessarily in the brewing industry, technical engineering qualifications and experience in processing and packaging plant.

Age will be between 25 and 32.

Commencing salary will be not less than £1150, depending on qualifications and experience. Salaries are reviewed annually.

The Company has a contributory pension scheme which the successful candidate would be required to join.

Applications should be made to :

The Personnel Manager,
Joshua Tetley & Son Ltd.,
The Brewery,
Leeds, 10.

E9649 A

SITUATIONS VACANT

BICC

have an interesting and progressive post to offer a

RUBBER TECHNOLOGIST OR CHEMIST

qualified to degree standard or equivalent, at their Wiring & General Cables Division at Leigh, near Manchester. The work involves the development of natural and synthetic rubber compounds and their utilisation in the electric cable industry. Previous experience is desirable, but not essential. Salary according to age and experience. Staff superannuation scheme in operation. Written applications, stating age, experience and qualifications, should be addressed to :

PERSONNEL OFFICER,
BRITISH INSULATED CALLENDER'S CABLES, LTD.,
ANCHOR WORKS, LEIGH, LANCS.

E9659 A

SITUATIONS VACANT

MECHANICAL OR STRUCTURAL ENGINEERS OR MATHEMATICIANS

for ***DESIGN WORK*** *on*

SPECIAL PRESSURE VESSELS

and

STRESS ANALYSIS PROBLEMS

required by

BABCOCK & WILCOX LIMITED

in their

ATOMIC ENERGY DEPARTMENT

in London.

Write, giving details of qualifications and experience to:—

The Assistant Secretary, 209, Euston Road, London, N.W.1.

E9656 A

BLACK & DECKER LIMITED

require

JUNIOR ENGINEER DRAUGHTSMAN

Age 20–38. Some experience in engineering for light industrial mass production. H.N.C. or O.N.C. Responsible for preparation and checking engineering drawings, data sheets, etc., for Production Division. Investigation of Production queries regarding product design, implementing minor modifications. Checking designs for inter-company standardisation.

Good commencing salary. Encouragement to earn promotion in a dynamic growth Company. Usual benefits of a progressive organisation.

Tel. Mr. P. Banks—Skyport 2411 or write to:

BLACK & DECKER LIMITED,

Harmondsworth, Middlesex
(situated near London Airport)

E9662 A

VAUXHALL MOTORS

invites applications for the position of

CHIEF POWER HOUSE ENGINEER

This appointment carries responsibility for the operation and maintenance of :
(*a*) water tube boiler plants of a total capacity of 500 million B.T.U's per hour, producing high temperature hot water for process and space heating ;
and (*b*) a gas producer plant of a capacity of 400,000 cubic feet per hour.

All plants are fully instrumented for maximum fuel economy and the successful candidate will be called upon to keep detailed records and to prepare regular heat balance data for Management scrutiny.

Good theoretical and technical knowledge, together with previous experience of operating similar plants in a supervisory capacity, are essential requirements.

The Company operates sickness insurance, life assurance and retirement pension schemes ; and housing assistance will be given if necessary.

Please write, with details of experience, technical qualifications and including present salary to the

STAFF EMPLOYMENT MANAGER,
VAUXHALL MOTORS LTD., LUTON, BEDS.

E9729 A

RALEIGH INDUSTRIES LIMITED NOTTINGHAM

CAREERS FOR YOUNG QUALIFIED ENGINEERS

RALEIGH INDUSTRIES offer career opportunities in their DESIGN DIVISION to young QUALIFIED ENGINEERS.
Good salaries will be paid whilst experience is gained and graduation to senior positions will be available to suitable candidates.
These appointments will interest particularly young engineers between 23–30 years, who are University graduates or are in possession of H.N.C. Mechanical Electrical engineering, or the equivalent, and who have the appropriate engineering industrial training.
Type of work—MECHANICAL AND ELECTRICAL DESIGN AND DEVELOPMENT work on light-weight vehicles and associated equipment manufactured in quantity by modern techniques.
Good salaries are available in which special recognition is made of technical qualifications.
Conditions, prospects, and opportunities are good : the posts are permanent and pensionable.
In appropriate cases assistance with the payment of removal expenses is available.
Apply, giving details of age, experience, qualifications and quoting M/ER. to the Works Personnel Manager, Faraday Road, Nottingham.

E9646 A

DRAUGHTSMEN

Stable employment with prospects of promotion in an interesting job, is offered by English Electric Co., Ltd., Rugby, to experienced mechanical draughtsmen.

Vacancies exist for men experienced in general mechanical design, plant layout work including piping arrangements, or condenser and feed heating plant. To be really suitable for these positions applicants should have served a recognised apprenticeship, have a H.N.C. (the work demands it and promotion depends upon it) and have several years D.O. experience.

If you are interested, write giving full details to Dept. C.P.S., Marconi House, Strand, London, W.C.2, quoting reference E. 1199B.

E9671 A

ATOMIC ENERGY RESEARCH ESTABLISHMENT
HARWELL

requires

ENGINEERS

to be responsible on shift for the operation of a high flux research reactor and ancillary plant.

The vacancies offer an interesting career to experienced engineers who have shift or watch keeping experience on large chemical, electrical, mechanical or marine plants, and should appeal to ex-Service technical officers.

Additionally, some shift posts offer first-class training to young engineers with good academic qualifications, who wish to enter the nuclear energy field.

Applicants should have served a recognised engineering apprenticeship or have had equivalent training, and should be Corporate Members of the appropriate Engineering Institution or have equivalent qualifications.

Nuclear experience not necessary as training will be given on full salary.

SALARY : £845 (at age 25)–£1315 p.a.,
or £1345–£1800, according to age and experience.
Plus a shift allowance of £60 p.a. approx.

Housing and contributory pension scheme.

Send POST CARD for details to the Group Recruitment Officer, (1646/25), U.K.A.E.A., A.E.R.E., Harwell, Didcot, Berks.

E9647 A

SITUATIONS VACANT

START-UP ENGINEERS

Qualified Engineers with experience in the processing industry and with aptitude and some experience of operations of chemical, refinery or allied type plants. Will be responsible to the Chief Start-Up Engineer and be in charge of site operations from pressure test to final acceptance. Must be able to deal with personnel at all levels from labour staff to client representative and to prepare reports and undertake special tests as required, for equipment evaluation. Must be free to travel abroad and be away from home for extended periods.

START-UP TECHNICIANS

Minimum G.C.E. standard with 2 to 5 years' experience in an engineering/construction firm and be conversant with engineering terminology and materials of construction. Technical or craft apprenticeship would be an advantage. Will work as shift operators in a start-up crew in support of the Senior Start-Up Engineer. Must be free to travel abroad and be away from home for extended periods.

Apply in writing to :—

Personnel Manager,
AIR PRODUCTS (G.B.), LTD.,
49/50, POLAND STREET,
LONDON, W.1.

E9691 A

SITUATIONS VACANT

DESIGN ENGINEERS

required for interesting and varied work in connection with special purpose machinery and structures in the medium/heavy range.

Applications are invited from candidates, aged 26–35, preferably qualified to A.M.I. Mech.E., but H.N.C. with suitable experience acceptable.

These are permanent and progressive positions with attractive salaries.

The works are pleasantly situated within 15 minutes' bus ride of Ipswich. Good canteen facilities and a contributory pension scheme. Holiday arrangements respected.

Write, giving full details of age, qualifications, experience and salary required, to :—

THE PERSONNEL OFFICER,
THE BRITISH STEEL PILING COMPANY, LIMITED,
ZENITH WORKS,
CLAYDON, NR. IPSWICH, SUFFOLK.

E9681 A

WORKS CONTROLLER

One of Britain's leading domestic appliance manufacturers requires Works Controller to organise planning and production of combination washing machine and spin-dryers and similar appliances. Applicants must have extensive knowledge and experience of the washing machine or domestic appliance industry.

Salary : £2500 p.a., plus excellent bonus.

Apply BOX No. E9703, "The Engineer."

A

SITUATIONS VACANT

SIMMS MOTOR UNITS LTD

TECHNICAL REPRESENTATIVE IN U.S.A.

The Company wishes to appoint a Technical Representative who will be based on Detroit, U.S.A. The successful applicant will preferably be in the age range 35/40 and will have an engineering background. He should be technically educated to Higher National Certificate Standard and possess some experience of Fuel Injection Equipment as applied to automotive type Diesel Engines. Diesel engine development experience would be an added advantage.

DUTIES :

To act as liaison between the respective Engineering Departments in America and England.

To assist the Engine Manufacturers in America with the application of Fuel Injection Equipment to their Engines.

To assist in building up appropriate contacts between the respective Engineering, Purchase, Production and Service Divisions.

Salary will be appropriate for the position plus expenses.

Applications should be addressed to :

CHIEF PERSONNEL EXECUTIVE,
SIMMS MOTOR UNITS LTD.,
EAST FINCHLEY, LONDON, N.2.

E9711 A

RAILWAY ELECTRIFICATION

The Railway Modernisation Programme, increasing in activity, offers excellent opportunities to men qualified and experienced in Structural and Civil Engineering.
British Insulated Callender's Construction Co. Ltd. have immediate vacancies for the following positions :

DESIGNERS

Ref. 'A' First Class Designers capable of working with the minimum of supervision.

Experienced in the design of light steel-framed portal structures and associated foundations.

Ref. 'B' Structural or Civil Engineering Designers experienced in general structural engineering and/or foundation design.

Conditions of employment are excellent, including Bonus and superannuation schemes.

These vacancies are at Kirkby, near Liverpool, where interviews for selection will take place. Please submit application in writing, stating age, education and previous experience to :

THE PERSONNEL OFFICER,
BRITISH INSULATED CALLENDER'S CABLES LTD.,
PRESCOT, LANCS.

A member of the **BICC** Group of Companies

E9668 A

THE MOTHERWELL BRIDGE & ENGINEERING COMPANY LTD.

DESIGN ENGINEERS

ASSISTANT CHIEF DESIGNER (REF. DD-1)

Applications are invited for the above post from honours graduates in Mechanical Engineering who have had several years' experience in the design of Pressure Vessels, Chemical Plant and refinery equipment, and, in addition, design experience in structural steelwork.

Applicants should be between 30 and 35 years of age and be corporate members of the Institution of Mechanical or Structural Engineers.

Duties will include the execution and responsibility for checking of designs. Applicants should have a good bearing and pleasant manner and be willing to travel, as the scope of the position will extend to meeting representatives of other companies on technical matters.

An attractive commencing salary is offered and will be based upon the qualifications and experience of the successful applicant.

DESIGN ENGINEER (REF. DD-2)

Applications are invited from Engineers holding a degree or equivalent qualification in Mechanical or Structural Engineering for specialised design work on Gas, Chemical and Oil Refinery Plant and Equipment.

Applications from Engineers graduating this year will be considered.

The position carries responsibility for the execution of original designs and offers a wide scope for engineers wishing to specialise in this type of equipment. Commencing salary will be not less than £800 p.a., but would be increased above this depending on age and experience.

Both posts are pensionable and the company offers excellent Canteen and recreational facilities. Apply, quoting reference number and giving full details of qualifications and experience, to The Motherwell Bridge & Engineering Co. Ltd., P.O. Box 4, Motherwell.

E9596 A

BRIDGES

DESIGNERS AND DRAUGHTSMEN

with experience in bridge work are required by London Consultants. At least one vacancy would suit a man who has specialised in bridge design for a number of years. Good conditions and prospects.

Please write full details of past experience to BOX No. E9672, "The Engineer."

A

SITUATIONS WANTED

21 YEARS OLD SWISS, qualified precision mechanic seeks employment in England to learn English.—Write to Jost Wallimann, Foppaweg 14, Chur (Gr.), Switzerland. E9667 B

STRUCTURAL ENGINEER. Experienced Works Manager with good general knowledge of trade including Sales and Erection requires post London, S. or S.W. England.—BOX No. E2830, "The Engineer." B

TECHNICAL AND ENGINEERING TRANSLATIONS undertaken, German/English, speedy service.—BOX No, E9828, "The Engineer." B

MECHANICAL ENGINEER, B.Sc. (Eng.), A.M.I.Mech.E., age 30, machinery construction and design experience seeks position in London.—BOX No. E9828, "The Engineer." B

BUSINESSES and PREMISES

SMALL SHEET METAL BUSINESS situate at Harlesden, N.W.10. Freehold Premises 2500 sq. ft., with 6-roomed House in addition. Plant and Equipment in good working order. For Sale as Going Concern. Price £8000.—Further particulars of HENRY BUTCHER AND CO., 73, Chancery Lane, W.C.2. Tel. HOLborn 8411. E9709 L

BUSINESS OPPORTUNITIES

A BARGAIN. £25 complete. BRAND NEW READY-MADE CO. REGNS. Guaranteed no trading (ENGLAND OR SCOTLAND)—all trades available NOW, including Engineering ; Electrical Engineering ; Motor Engineering ; Garage ; Machinery ; Metal ; Haulage ; Hire Purchase ; Investment ; Property (specially prepared for each trade).—BUSINESS ECONOMY CO. REGNS. LTD., Dept. T/16, 156, Strand, London, W.C.2 (Tem. 8377/2294), for English companies, and to 19, Walker Street, Edinburgh, 3 (Cal. 1167/8/9), for Scottish Companies. Read "ADVANTAGES OF TRADING AS A LIMITED COMPANY" (3s. post free) ; Limited Co. may save you tax. We have seven-day Co. Regn. service with your own choice of name. £21 complete, plus stamp duties. E182 o

REMPLOY SPONSORSHIP SCHEME

Send for details which show an attractive proposition to manufacturers.
Write to the MANAGING DIRECTOR, REMPLOY LTD., 25-28, BUCKINGHAM GATE, S.W1, or telephone VICtoria 6621 (12 lines).

E9665 o

SUB-CONTRACTING

KELLERING AND CAM PROFILING capacity up to 8ft. by 6ft. or 6ft. diameter.—ARMYTAGE BROS. (KNOTTINGLEY), Ltd., The Foundry, Knottingley, Yorkshire (Telephone : Knottingley 2743/4). E116 MW

PATENTS

THE PROPRIETOR of British Patent No. 770,669, entitled "SLOTTED SCREW HEAD," offers same for Licence or otherwise to ensure practical working in Great Britain.—Enquiries to Singer, Stern and Carlberg, 140, S. Dearborn Street, Chicago 3, Illinois, U.S.A. E9678 H

AGENCIES

SOUTH WALES ENGINEERING COMPANY with large amount of manufacturing capacity available, require AGENTS to introduce contract or sub-contract work, on a commission only basis.—BOX No. E2814, "The Engineer." D

Classified Advts. continued on page 148

FOR HIRE

LATTICE STEEL ERECTION MASTS (light and heavy), 30ft. to 150ft. high, for immediate hire.—Bellman's, 21, Hobart House, Grosvenor Place, S.W.1. B103 K

MISCELLANEOUS

LUSOL

KILLS RUST AND LUBRICATES

LUSOL The Rust Solvent is invaluable for Dismantling, Repairing and Overhauling Engineering Equipment. Obtainable from your usual Supplier. Enquiries to the manufacturers :—

The Great Eastern Oil Co., Ltd.,
372, Scotland Street, Glasgow. Tel. : South 2207
E184 I

DAVIES INVESTMENTS LTD.,
BANKERS

Continue to offer 7½ per cent. per annum on deposits, with extra ½ per cent. added annually on each £500 unit.
Details from Investment Dept. ER.
DAVIES INVESTMENTS LTD.,
DANES INN HOUSE, 265, STRAND,
LONDON, W.C.2.
E178 I

MACHINERY Etc. WANTED

MOST URGENTLY REQUIRED
SECOND-HAND HEAVY DUTY ROLL TURNING LATHE, not less than 30in. height of centres (i.e. 60in. swing over bed). Make and condition immaterial.—BOX No. E9654, "The Engineer." F

FOR SALE

WARD NO. 7 TURRET LATHE

Height of centres	7in.
Between centres...	27in.
Swing over bed ...	14¼in. dia.
Swing over saddle	12¼in. dia.
Bore of spindle ...	2⅛in. dia.
Screwing capacity	4 to 28 T.P.I.
Chuck	4 Jaw 12in. dia.
Speeds...	8 range, 26 to 536 r.p.m.
Feeds (sliding and surfacing) ...	15 range, 0·0036in. to 0·077in.

Inspection invited by appointment of Appleby-Frodingham Steel Company, reference P/EB, Scunthorpe, Lincolnshire. E9593 G

FOR SALE

HYDRAULIC PRESSES
OF ALL TYPES

10,000-ton Hydraulic Free Forging Press, bed 13ft. by 8ft., stroke 8ft. 3in., with accumulator and pumps, approx. weight 1300 tons.
4000-ton Multi-Daylight Hot Plate Press, four rams, platens 8ft. 6in. by 4ft. 6in., with self-contained pumping unit.
3000-ton Heavy Forming or Drawing Press, table 10ft. 6in. by 6ft.
2000-ton Forging Press, bed 8ft. by 8ft., 11ft. daylight.
1250-ton Vertical Extrusion Press, with self-contained pumping unit.
500-ton Flanging Press, vice rams, table 10ft. diameter.

REED BROTHERS (ENGINEERING), LTD.,
Replant Works,
Woolwich Industrial Estate,
London, S.E.18.
Tel.: Woolwich 7611/6. E9673 G

FOR SALE
500 TONS MILD STEEL PLATES

New and Works Surplus—All Sizes. ⅛in. to 6in. thick. 4ft. by 2ft. to 20ft. by 6ft.
Current Stock list of sizes available, sent on application.
Write or Telephone :—
COX & DANKS LTD.,
FREDERICK ROAD,
SALFORD, 6.
Tel.: PEN 2481.
E9677 G

ONE HANSON & EDWARDS No. 3 4-headed Automatic Wire Winding Machine, suitable for copper and steel wire up to ⅛in. dia., bobbin size 22in. dia., having a bobbin speed 280 r.p.m., complete 2 sets spindles ⅜in. and 1in. dia. Equipment includes 4 swifts and Vee rope drive, but less motor and starter.—Best offers BOX No. E9707, "The Engineer." G

BUNKER CLAMSHELL GATES
LEVER OR AIR OPERATED
ALL STEEL CONSTRUCTION

MAXIM CONVEYORS (ENGLAND) LTD.,
BELVEDERE, KENT
Ring ERITH 34223 & 35751 E170 G

FOR SALE

SERVICE EDWARDS VALUE!

NEW BESCO Model E3/2 Pyramid Type Plate Bending Machine, motorised for 400/440/3/50, maximum plate width 49in., thickness 5/32in., diameter of top roll 3.15/16in., diameter of bottom rolls 3¼in., weight 1520 lb.
NEW BESCO Heavy Duty Universal Swing Beam Box Forming and Folding Machine, adjustable for producing a variety of shapes, such as trunks, channels, trays and mouldings, adjustable gauge and angle stop provided for repetition work, complete with sharp edge and radius blades, capacity 40in.×11 S.W.G., weight approximately 2090 lb.
PELS Type 30, Universal Punching, Shearing and Section Cropping Machine, steel plate frame, motorised for 400/3/50 supply, punches holes up to 1.5/16in. diameter through 1.3/16in. thickness, shears plates up to 1.3/16in. thickness, crops up to—rounds 2.9/16in., squares 2⅜in., weight approximately 10 tons.
NEW MUBEA All Steel Construction Bar and Angle Shear, enclosed flywheel and gears, motorised for 400/3/50, Model KSG.100, capacity : round and square bars 2in., flat iron 10in.×½in., 5½in.×1in., angles up to 4in.×½in., 5in.×0·425in., tee iron 5in., beams 6in., channels 6in., length of blades 12¾in.
LEE AND CRABTREE Guillotine Shearing Machine, Undercrank type, capacity 48in.×16 S.W.G., motorised for 400/440/3/50, length of blades 49½in., with sheet hold-down and all gauges.
BESCO Double-Geared Hand-Operated Universal Swing Beam Folding Machine, capacity 6ft. 2in.×¼in. thick, smallest trunk round beam 8¾in.×7¼in.
KENDRICK Hand-Operated Swing Beam Universal Folding Machine, for floor mounting, working length 6ft., maximum capacity 14 S.W.G. approximately, lift of top beam 1½in., weight approx. 30 cwt.

Photographs of the above are available.
Very favourable Hire Purchase terms can be obtained.

MACHINE TOOLS, NEW AND USED,
Of Every Description. Attractive Prices.

F. J. EDWARDS LTD.,
359-361, EUSTON ROAD,
LONDON, N.W.1.
Telephone : EUSton 4681-3771.
And at
LANSDOWNE HOUSE, 41, WATER STREET,
BIRMINGHAM, 3.
Telephone : Central 7606-8.
E207 G

FOR SALE

FRED WATKINS
(ENGINEERING) LTD.

Fielding 500-ton Vertical Downstroke Hydraulic Press, 42in. by 36in. platens, with pumps and motors.
Fielding 200-ton ditto, 3ft. stroke, with pumps and motors (5 available).
Fielding 100-ton ditto, 4ft. to 5ft. stroke, with pumps and motors.
Two 73ft. 4in. by 5ft. Brick Lined Kilns or Dryers, with Crofts reduction gears and motors.
Two 26ft. by 4ft. Rotary Cooler or Dryers, with reduction gear and motors.

FRED WATKINS (ENGINEERING), LTD.,
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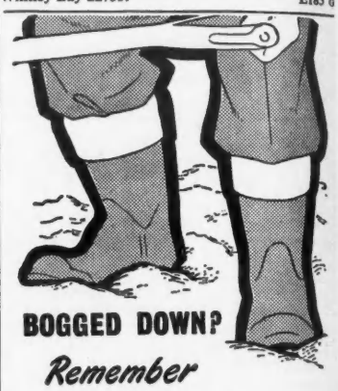
5-TON BOOTH STEAM LOCO. TRAVELLING CRANE, Jib 30ft., shunting carriage, dead buffers, standard gauge, wheelbase 6ft. 6in., cost £5700 in 1959, will accept £2500—also High Pressure Water-Tube Boiler, oil-fired, fully automatic, little used, 1000 lb. evap. hour at 400 lbs. p.s.i.—THORNTON MACHINERY, 5, Grosvenor Drive, Whitley Bay 22755. E185 G



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		Main Location	*Auctioneers*
May 10	Machine tools and miscellaneous stores, including:—	M.O.A. Storage Depot, Byley, Nr. Middlewich, Cheshire. (Sale at Cheetham Town Hall, Manchester, 8.)	J. H. NORRIS & SON (Dept. L), 9, Albert Square, Manchester, 2. (Tel.: Blackfriars 8373.)

Centre and turret lathes; pedestal and bench drills; surface and bench grinders; power hammer; M.T. spares; tilt sheets; tyres and tubes; electric motors; fluorescent and other lighting fittings; Lister 22kW and other generators; radio and electrical equipment; fan units; portable cranes; lift trucks and stillages; metal pallets; laboratory glassware and equipment; furniture; steel storage units; canteen equipment; Caterpillar type R.D.6 Bulldozer; greatcoats, overalls; khaki shirts; vests; etc.

May 17-20	Approximately 1,900 vehicles motor cycles, earth moving and lifting equipment.	M.O.A. Storage Depot, Ruddington, Notts.	WALKER, WALTON & HANSON (Dept. L), Byard Lane, Bridlesmith Gate, Nottingham. (Tel.: 54272.)

300 saloons, limousines and estate cars (including Rolls-Royce "Silver Wraiths" (automatic), touring limousine by Hooper, 120 Ford "Anglias," "Populars," and Morris "Minors"); Land Rovers, Jeeps, Austin "Champs," utilities, coaches, load carriers 10 cwt. to 16 tons, many fitted with diesel engines (including A.E.C. "Matadors" and 6×6 refuellers, Diamond "T" International "K.R.8" tractors with 16-ton Tasker trailers, Leyland "Hippos," Mack and Scammell tractors, Thornycroft "Trusty" tractor with 14-ton stepframe Tasker trailer); vans, tippers, trailers 10 cwt. to 20 tons, tankers 100 galls. to 2,500 galls.; excavators—20 Ruston Bucyrus "R.B.10's" Osgood rigged crane and clamshell bucket, Priestman "Wolf's" with face shovel back acter and dragline equipment; Ransomes and Rapier Model "410"; 45 mobile cranes (some lorry-mounted); Caterpillar "D.8" tractors; road rollers; Blaw Knox towed scraper; "Sheepsfoot" roller; Blaw Knox concrete finisher; Ford snow ploughs; machinery truck fitted saw bench lathe, etc.; wheeled tractors; trailer-mounted fire pumps; trailer and lorry-mounted diesel electric generators (some 230 volts); Broom-Wade diesel compressor; 550 solo motor cycles by Ariel, B.S.A., Matchless, Norton, Triumph, etc.; 6 and 12 volt batteries; metal truck bodies and cabs; plant ancillaries and spares by Caterpillar, Coles, Jones, Barber Greene, Ruston Bucyrus, Ransomes & Rapier, etc.

May 20	Clothing and miscellaneous stores.	Command Ordnance Depot, Coypool, Marsh Mills, Plymouth. (Sale at Kinterbury House.)	WOOLLAND, SON & MANICO (Dept. L), Kinterbury House, St. Andrew's Cross, Plymouth. (Tel.: 69292.)
May 24	Miscellaneous stores.	Command Ordnance Sub-Depot, Devizes. (Sale at Corn Exchange, Devizes.)	FARRANT, WIGHTMAN & PINNIGAR (Dept. L), 2, Newport Street, Swindon, Wilts. (Tel.: 5151/2).
June 10	Machine tools and miscellaneous stores.	Technical Stores Depot, Old Dalby, Leics. (Sale at Melton Mowbray.)	SHOULER & SON (Dept. L), 1, Norman Street, Melton Mowbray, Leics. (Tel.: 3081.)
June 16	Miscellaneous stores and Vehicles.	M.O.A. Storage Depot, Bowhouse, Hurlford, Nr. Kilmarnock, Ayrshire.	DIXON & WALLACE LTD. (Dept. L), Bank Buildings, Graham Street Glasgow, E.1. (Tel.: Bridgeton 2447/9.)
June 22	Miscellaneous stores.	Northern Command Ordnance Sub-Depot, Barlow, Nr. Selby, Yorks.	BARTLE & SON (Dept. L), 50-52, Merrion Street, Leeds, 2. (Tel.: 2.0898)

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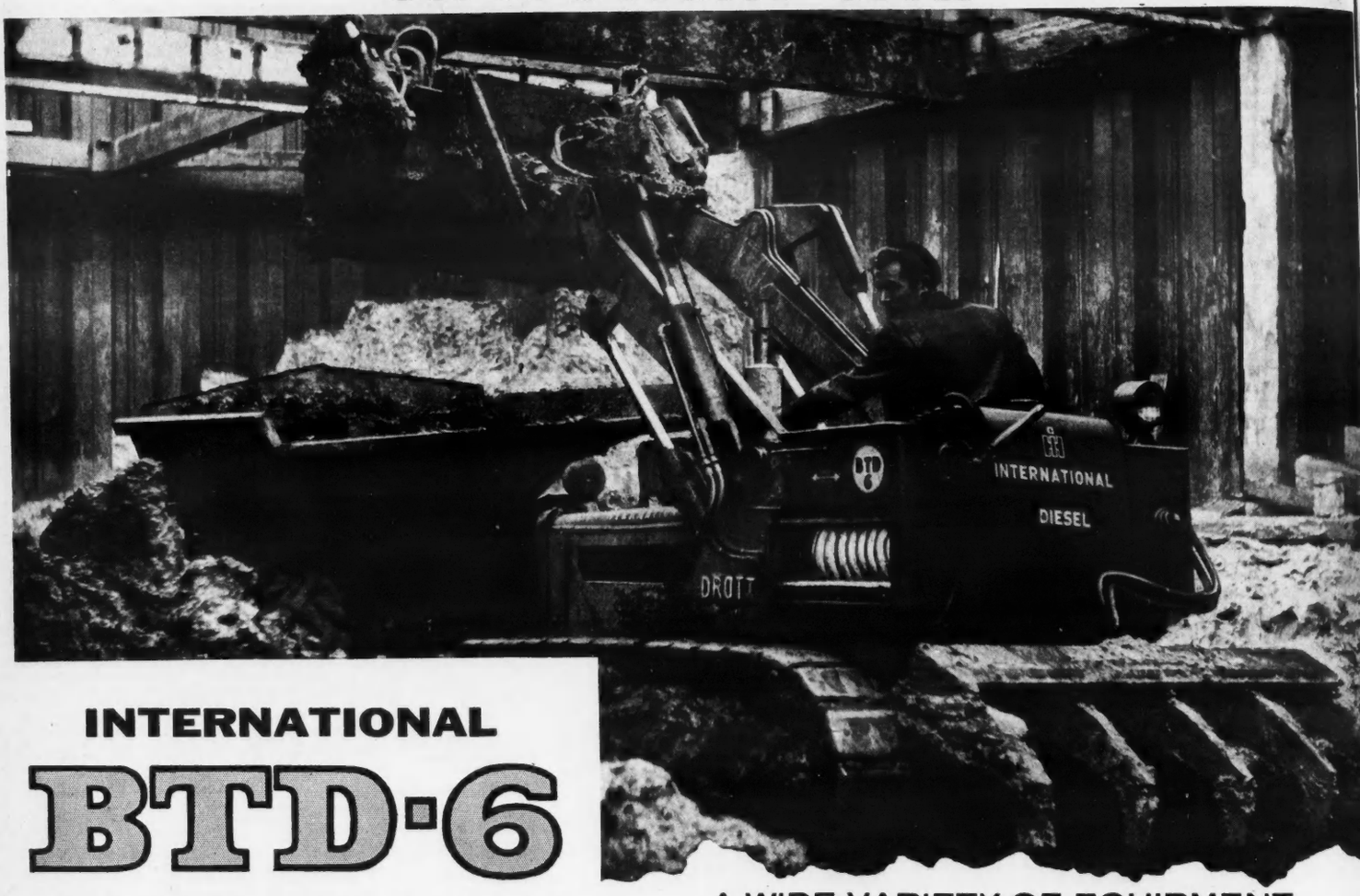

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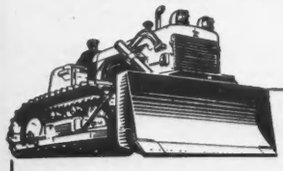

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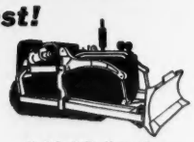
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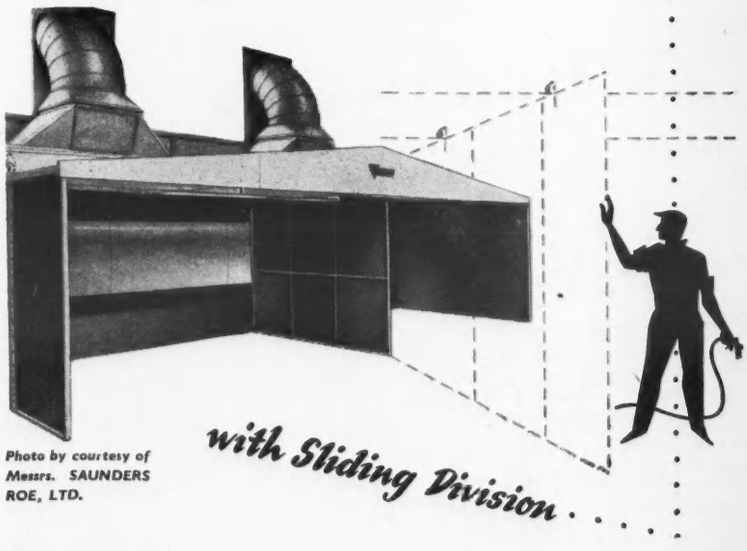

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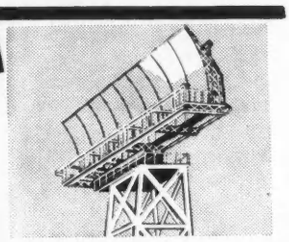

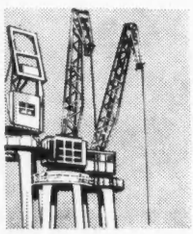

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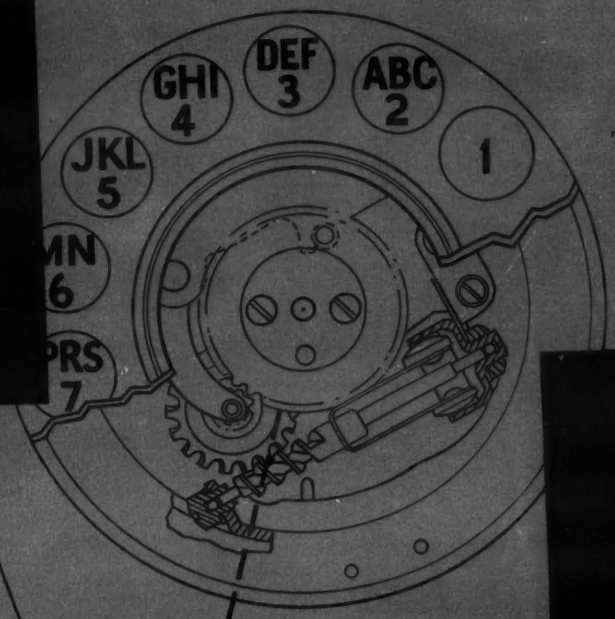

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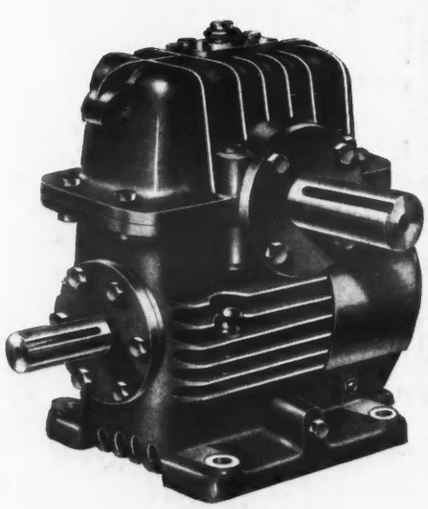

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